Fighting for Tyranny: State Repression and Combat Motivation

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We utilize over 100 million declassified Red Army personnel records from World War II to study how state repression shapes soldiers' motivation to exert effort in fighting. Exploiting multiple complementary identification strategies, we find that soldiers from places with higher levels of pre-war repression under Stalin's rule were more likely to fight until death and less likely to shirk their duties, but they also received fewer decorations for personal bravery. The coercive incentives created by repression appear to have induced obedience at the expense of initiative and increased the human costs of war.
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The development and survival of states often hinges on their ability to extract resources for war-making from their populations (Tilly, 1985). In modern mass warfare, one such key resource is the effort that ordinary citizens exert on the battlefield. What drives individuals to risk their lives, resist the temptation to flee, and take personal initiative when fighting for their country? Because the conduct of individuals in war has far-reaching economic and political consequences (Acemoglu, Autor and Lyle, 2004; Scheidel, 2018), a deeper understanding of combat motivation at the micro-level is essential.

Existing research has examined the role of pecuniary incentives (Grossman, 1991; Hall, Huff and Kuriwaki, 2019), ideology (Barber IV and Miller, 2019), group loyalties (Shils and Janowitz, 1948; Costa and Kahn, 2003), status competition (Ager, Bursztyn and Voth, 2022), fear of punishment (Chen, 2017), and discrimination (Lyall, 2020) in motivating individuals to fight. We propose a complementary perspective, which underscores soldiers' prior interactions with the state outside their line of duty. If we accept the long-held premise that military institutions do not evolve in isolation from broader society and politics (Clausewitz, 1832/1984, 592-593), then we must also acknowledge the importance of lived experiences vis-a-vis the state that soldiers had before their service. Soldiers for whom these experiences were mostly positive may approach their duties differently than ones who have come to see their state as unjust or tyrannical.

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We conduct a quantitative individual-level study of the military effort of the Soviet Union during World War II, which is arguably the most paradigmatic case for the question at hand. Within the span of a few years, the Soviet state headed by Josef Stalin went from inflicting mass terror against its people to rallying those same people to fight in its name, in what became the world's deadliest-ever conflict. The Great Patriotic War — the eastern front of World War II — accounted for 93% of European casualties in the war and 18 of the 25 costliest battles on record (Overy, 1998, xvi). The Soviet Union lost over 11.2 million military personnel and 17.9 million civilians (Surinov and Oksenoyt, 2015). Almost 40% of the battlefield losses comprised soldiers who surrendered, deserted, or went missing (Krivosheev, 1997). Historians have puzzled over these numbers and debated whether Stalin's prewar coercion alienated the population to the point where many did not want to defend their homeland (Edele, 2017; Thurston, 2000). Incentives to avoid fighting were compelling: in the battle of Stalingrad, for example, the average life expectancy was 24 hours for enlisted Soviet soldiers and three days for officers (Merridale, 2006). Given these odds, it is remarkable that the Red Army managed to keep millions of its troops in line fighting while others fled (Reese, 2011).

The study's goal is to explain how prewar mass violence by the state impacts the combat motivation of soldiers during war. To this end, we collected detailed data on the Red Army in World War II. Using 106 million declassified personnel records, we reconstruct the wartime trajectories of almost 12 million soldiers. We link these wartime records with micro-level data from over 2 million secret police case files on state repression prior to the war. We then evaluate whether exposure to prewar repression could in part explain why some soldiers fought to the death while others surrendered, deserted, or went missing, and why some received decorations for valor in battle but others did not.

To validate our measures of soldier-level outcomes, we show that these outcomes map consistently onto the aggregate performance of the units in which those soldiers served. The Red Army was more likely to gain territory in battles where a higher share of its soldiers was killed or wounded, a lower share went missing, surrendered, deserted, or showed insubordination, and a higher share received awards for bravery. Because territorial gains are standard measures of aggregate combat performance in ground warfare (Biddle, 2004), these correlations suggest that we can plausibly interpret a soldier's death in battle or award for bravery as indicators of high combat resolve, and going missing, deserting, surrendering, or insubordination as indicators of low combat resolve.

An obvious limitation of this study is that repression was not completely random. We exploit several features of Stalin's repressive apparatus that help with causal identification. First, mass terror targeted particular groups of people based on their ethnicity, class, and region of residence. However, there was little differentiation between the individuals or communities within those demographic categories. We compare the outcomes of soldiers who originate from geographically proximate communities with differential levels of repression, while accounting for the same observables that the regime used when selecting group-level targets. Our identifying assumption here is that such controlled comparisons remove or at least minimize the "systematic component" in the allocation of repression.

Our second empirical approach exploits the fact that local administrators had wide discretion in implementing repression. We utilize discontinuous changes in arrest levels across administrative borders as a plausibly exogenous source of variation in repression. Because the Soviets redrew administrative borders just before the Great Terror campaign, a common problem with geographic regression discontinuity designs — that many things besides treatment vary across borders — is less formidable in our context. Balance tests indicate that communities residing near administrative borders were identical across many socio-economic characteristics and differed only in their exposure to repression, likely due to idiosyncratic differences in the local coercive apparatus.

Across both empirical approaches, we find that soldiers from places with high levels of prewar repression had systematically different battlefield outcomes compared to others: they were more likely to be killed or wounded in action; they were less likely to go missing, desert, surrender or defy orders; yet they also showed fewer personal acts of bravery as far as we can judge from their award records. The results remain consistent across a wide range of robustness checks, including a matched cluster design that compares soldiers from birth locations with similar socio-demographic characteristics, including estimated population size; regressions with aggregate data at the level of soldiers' birthplaces or home districts; analyses that adjust for the interdependence of soldiers' decisions within units; an instrumental variable design that exploits the logistical constraints faced by the state in reaching and transporting victims; and an expansion of the sample to include soldiers born in Soviet Ukraine (for which the data have lower quality).

We rationalize these empirical patterns using a stylized model of soldiers' decision-making process, which focuses on trade-offs between intrinsic and extrinsic motivation (Bernheim, 1994; Benabou and Tirole, 2003). Soldiers who learn firsthand about the repressive nature of their state might become intrinsically less willing to fight for it. At the same time, repression might increase soldiers' extrinsic incentive to fight, as exposed individuals come to expect that they — or even their families — may be punished for the slightest hint of disloyalty. Due to these countervailing forces, repression leads to "perfunctory" rather than "consummate" compliance (Brehm and Gates, 1999), where soldiers are willing to obey orders but hesitate to take personal initiative. The model predicts that repression increases combat resolve at the low end of the distribution (gains in compliance), but reduces resolve at the high end of the distribution (loss of initiative).

To conduct a more direct test of this distributional effect of repression, we construct an index of combat resolve using aggregated data on Red Army units. This index is the predicted probability that a unit participated in a battle that resulted in a territorial gain, conditional on average soldier-level outcomes in that unit. Consistent with our theoretical logic, we show that the distribution of this index has a higher mean and lower variance in units whose soldiers came from locations with higher average levels of repression.

An alternative interpretation of our results is that they reflect wartime discrimination against soldiers from heavily-repressed locations, rather than the choices soldiers made in battle. These soldiers may have died at higher rates because they were selectively assigned to more dangerous parts of the front, or to units with worse leadership and equipment. Officials may also have denied these soldiers awards for bravery, regardless of merit.

While we cannot conclusively rule out these possibilities, there are several important patterns in our data that discrimination cannot fully explain. For example, we find no evidence that soldiers from heavily-repressed areas were overlooked for promotions, or were more likely to be assigned to units with more exposure to enemy fire. We find the same systematic differences when we compare soldiers serving concurrently in the same units, who were exposed to similar battlefield conditions and unit leadership, and had similar kits. We also estimate regressions with time-varying effects and find that the variation in estimates is consistent with our proposed interpretation.

The tension between pre-war state violence and wartime combat mobilization has surfaced in many conflicts, including the Iran-Iraq War (Pollack, 2004, 182), the Second Congo War (Lyall, 2020, 332), and the civil war in Syria (Heydemann, 2013). Several properties make the Soviet case especially suitable for empirical analysis. Highly bureaucratized Soviet military administration generated enormous amounts of granular data, permitting quantitative study of the largest-ever military effort at the level of individual soldiers. Furthermore, due to a nearly universal draft of the adult male population, we can avoid problems of self-selection into the military. The Soviet case allows us to partial out two factors central to earlier literature on combat motivation: unit cohesion and pecuniary incentives. Personnel turnover was too fast — due to conscription and combat losses — to secure the types of inter-personal bonds documented in other armies (Merridale, 2006); the Red Army offered no material inducements for combat performance.[1]

Our study contributes to several strands of literature in empirical political economy. First is research on the micro-foundations of military effort. We show that soldiers' prior experiences of repression can undermine their intrinsic motivations to fight for material, ideological, or other reasons (Barber IV and Miller, 2019; Grossman, 1991; Hall, Huff and Kuriwaki, 2019). By focusing on repression prior to war, our study complements recent scholarship on the coercive incentives that soldiers face during war (Chen, 2017; Lyall, 2020). Our results suggest that soldiers who had experienced state violence more intimately as civilians may be more responsive to coercive measures on the battlefield.

[1] Soviet veterans received temporary benefits to assist with reintegration into civilian life (e.g. easier access to higher education) during mass demobilization in 1945. Other veterans' benefits (e.g. interest-free loans for housing construction, travel discounts) came into effect only in the 1970s (Edele, 2006).

More broadly, this article extends research on how states' exploitative and coercive practices impact development (Dell, 2010), social structure (Acemoglu, Hassan and Robinson, 2011), trust (Grosjean, 2014), behavior (Rozenas and Zhukov, 2019), and identity (Blaydes, 2018). Our findings highlight a previously overlooked negative externality from repression on states' ability to provide the most basic public good: national security.

I. Repression and Combat Resolve

Military institutions do not exist in a social vacuum. Whether they are conscripts or professionals, soldiers bring a variety of life experiences from the civilian domain to the battlefield. Depending on their prior interactions with the state, soldiers may differ in their intrinsic willingness to fight in the name of their state. They may also have variable expectations about how the state will react if they shirk or defect in the line of duty.

How does differential exposure to state violence in civilian life impact the resolve of soldiers in combat? Existing research does not provide a clear answer. There is systematic evidence that violence provokes negative sentiments toward the perpetrator (Blaydes, 2018; Dell and Querubin, 2018; Grosjean, 2014; Rozenas and Zhukov, 2019). In the military context, ethnic groups that face discrimination in the civilian domain are less willing to fight for the state (Lyall, 2020) and more willing to rebel against it (Cederman, Wimmer and Min, 2010). This implies that soldiers who are more intimately aware that they are fighting for a repressive, unjust state should exhibit lower combat resolve. We refer to this as the alienating effect of repression.

The intrinsic willingness to fight is not the only driver of a soldier's behavior. Like any organization, the military relies on extrinsic, sometimes coercive incentives to overcome low intrinsic motivation among its personnel. The costs of shirking — retreating or hiding when ordered to charge — can include demotion, court-martial (Chen, 2017), execution (Statiev, 2010), even retaliation against family members (Reese, 2011). As Beissinger (2002, 326) writes, repression works by creating "internalized expectations about [how] authority will respond punitively to challenging acts." A soldier exposed to repression in civilian life may see the state's threat of punishment on the battlefield as more credible and, therefore, may exhibit higher resolve than they would prefer based solely on their intrinsic motivation. This is the deterrent effect of repression.

Because the two effects of repression are in competition with each other, it is not obvious how their interaction should ultimately impact the behavior of soldiers in battle. To untangle this problem, we employ a stylized model of soldiers' choices.

A. A Stylized Model

There is a continuum of soldiers indexed by type $\omega \in \mathbb{R}$, representing their *intrinsic* combat motivation, drawn from the distribution F.[2] Each soldier chooses an action $a \in \mathbb{R}$, which denotes the level of *combat effort* they exert on the battlefield at the risk of injury or death. For concreteness, let $\overline{a}$ denote the action ordered by commanders (e.g., "charge!") and let $\underline{a}$ denote a cutoff such that if $a < \underline{a}$, the soldier shows especially low resolve that can be considered shirking (i.e., minimizing the risk of death or injury by deserting, surrendering, or going missing). As a soldier's combat effort approaches $\overline{a}$, they are showing increasing compliance. If the effort exceeds $\overline{a}$, the soldier is taking personal initiative by going above and beyond what they were ordered to do: being the first to storm enemy positions, personally capturing an enemy officer, assisting the wounded under enemy fire, or continuing to carry out one's mission in a burning tank.

To model the alienating effect of repression, suppose that the intrinsic motivation to fight for a soldier exposed to repression level $r \geq 0$ is $\omega - \alpha r$, where α is the "alienation" parameter. Action a results in an intrinsic loss of $(a - (\omega - \alpha r))^2$ for the soldier. Absent other considerations, a soldier would minimize the loss by choosing $a = \omega - \alpha r$.

To model the deterrent effect, suppose that a soldier who shows *less* resolve than required by commanders suffers an extrinsic loss of $\mathbb{E}(\pi|r)(\overline{a} - a)^2$, where $\mathbb{E}(\pi|r)$ is the penalty that a soldier expects to receive for under-performance. Let $\mathbb{E}(\pi|r) = \delta r$, where $\delta \geq 0$ is the "deterrence" parameter.[3] A soldier exposed to more repression will infer that the state's ability to punish is higher and will be more reluctant to shirk.

Each soldier chooses an optimal level of combat resolve a^* to minimize the sum of their intrinsic and extrinsic losses:

$$a^* \in \arg\min_{a \in \mathbb{R}} (a - (\omega - \alpha r))^2 + \delta r (a - \overline{a})^2 \mathbb{1}\{a < \overline{a}\}, \tag{1}$$

which solves to

$$a^*(\omega, r) = \begin{cases} \dfrac{\omega + r(\delta \overline{a} - \alpha)}{1 + \delta r} & \text{if } \omega \leq \overline{a} + \alpha r; \\ \omega - \alpha r & \text{otherwise.} \end{cases} \tag{2}$$

The optimal combat resolve a^* is increasing in repression r for soldiers with low intrinsic motivation, $\omega \leq \overline{a} - \alpha/\delta$, and decreasing for soldiers with high intrinsic motivation $\omega > \overline{a} - \alpha/\delta$. In the former case, the deterrent effect of repression dominates the alienating effect (pushing a^* up); in the latter, the alienating effect

[2] F has full support, is increasing everywhere, and has a density f.

[3] The setup could be micro-founded with a signaling model, where r depends on the state's type ("repressive capacity").

dominates the deterrent effect (pulling a^* down). The following proposition specifies how these two countervailing effects of repression alter the overall distribution of combat resolve.

Proposition 1. *For each $\alpha > 0$ and $\delta > 0$, there is an $\tilde{a}(\alpha, \delta)$ such that, if $\overline{a} \geq \tilde{a}(\alpha, \delta)$, then $\mathbb{E}(a^*(\omega, r))$ is increasing everywhere in r, while $\Pr(a^*(\omega, r) < \underline{a})$ and $\Pr(a^*(\omega, r) > \overline{a})$ are decreasing everywhere in r.*

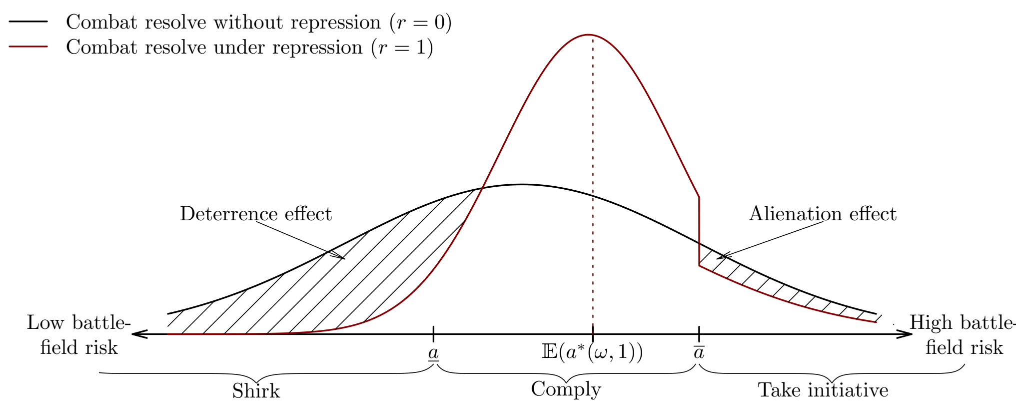

Figure 1. How repression shapes combat resolve

Figure 1 illustrates the logic behind this proposition (see Appendix A1 for the proof). The black curve is the density of combat resolve without repression where $a^* = \omega$. The red curve is the density of combat resolve under repression ($r = 1$). The density under repression has a higher mean $\mathbb{E}(a^*(\omega, r))$, but it also has lower variance as the tails of the distribution are squeezed inwards. Repression increases the extrinsic incentive to obey orders (soldiers with low intrinsic motivation ω show more resolve than they would otherwise), but it saps the intrinsic motivation to take initiative beyond the formal mandate (soldiers with high intrinsic motivation ω show less resolve than they would otherwise).

B. Observable Implications

We cannot observe soldiers' intrinsic motivation (ω) or combat resolve (a^*), but only discrete outcomes like whether a soldier died or survived, received a medal, deserted, surrendered, or shirked their duties in some other manner. To test our proposition, we need to map these observable outcomes, in a theoretically plausible way, to latent combat resolve. In doing so, we follow the precedents set in earlier literature.

To measure low combat resolve ("shirking"), we use desertion, surrender, absence without official leave, and disciplinary transgressions — following the approach by Costa and Kahn (2003) in their study of the U.S. Civil War, and cross-national research on conventional warfare (Lehmann and Zhukov, 2019; Lyall, 2020). In our model, an observable instance of such actions could indicate that the soldier had shown low combat resolve ($a^* < \underline{a}$). To measure high combat resolve ("initiative"), we follow Barber IV and Miller (2019) and use medals for valor. Since valor decorations recognize acts of courage beyond what is normally expected of soldiers, a reasonable inference is that a soldier who received such an award showed combat resolve above what their orders dictated ($a^* > \overline{a}$).

Finally, how should we interpret, in our theoretical framework, a soldier's death on the battlefield? Although a soldier's survival depends on many factors beyond their control (i.e., battle intensity, competence of commanders, peer behavior), extant literature often uses battle deaths to assess actors' resolve in fighting wars. Because a higher level of effort typically carries a greater risk of physical harm, commitment to one's combat mission implies a tacit willingness to sacrifice oneself for the cause. This is true not only for suicide terrorism, where armed groups routinely screen for "reliable martyrs" who are unlikely to defect (Berman and Laitin, 2008), but in conventional war as well. Ager, Bursztyn and Voth (2022), for example, use the deaths of German pilots in World War II as a proxy for effort and/or risk-taking. Between two soldiers exposed to similar battlefield conditions while serving at comparable ranks, we assume that the soldier who died fighting likely showed higher resolve a^* than the one who survived — perhaps not as high as a soldier who received a decoration for valor, but certainly higher than soldiers who fled the battle.

Consistent with how we interpret these outcomes, a validation analysis in Section III.B shows that in battles where more soldiers died, fewer shirked, and more received awards, the Red Army tended to gain territory rather than lose it.

Three testable predictions follow from Proposition 1:

Predictions. *As soldiers' exposure to state repression increases, they become (1) more likely to be killed in action (higher average a^*), (2) less likely to shirk by deserting, surrendering, going missing, or being punished for disciplinary transgressions (less likely that $a^* < \underline{a}$), and (3) less likely to receive an award for valor (less likely that $a^* > \overline{a}$).*

The observable implications of our theoretical logic are distinct from some alternative explanations. One could argue that exposure to repression motivates soldiers to "signal their loyalty" by showing consistently higher resolve and initiative. But if that is true, then repression should lead to more deaths, less shirking, and *more* awards for valor. Alternatively, if repression had only an alienating effect, we should see *fewer* deaths, more shirking, and fewer medals among soldiers exposed to repression.

The most challenging alternative theory is that repression drives soldier-level outcomes not through soldiers' choices but through the discriminatory practices of the state. Soldiers more exposed to repression could die in larger numbers because authorities assign them to more dangerous posts, and they could be denied awards even if they deserve them. We conduct an array of empirical tests to assess the plausibility of this argument.

II. Soviet Repression and War Effort

Under Stalin's rule (1927-1953), the Soviet state officially convicted 3.8 million people for "counter-revolutionary" crimes, most in the 1930's.[4] The stated goal of this violence was to eliminate "anti-Soviet elements," but the regime had few means to identify who engaged in "counter-revolutionary" activities or held "anti-Soviet" views. Security officials targeted broadly-defined segments of the population, like residents of particular provinces or minorities, without discriminating between individuals within those demographic categories. Stalin directed his subordinates to cast a wide net: "because it is not easy to recognize the enemy, the goal is achieved even if only five percent of those killed are truly enemies" (Gregory, 2009, 196). Eventually, people of all backgrounds, including party officials, the military, and security agencies, "everybody from the Politburo member down to the street cleaner," became potential victims of state violence (Ulam, 1973).

Central authorities provided little concrete guidance as to who should be repressed. The NKVD's Main Directorate for State Security issued numerical quotas of persons to be executed or sent to camps in each region and "everything else depended on the ingenuity of Security operations personnel" (Solzhenitsyn, 1973, 69-70). Local executives often engaged in "exceptional competition" to exceed their quotas and signal administrative zeal (Chukhin, 1999, 76). The hard constraints on this competition were largely circumstantial: the need to cover transportation costs for those condemned to the camps, and to find "a place [to] bury the corpses" for the rest (Jansen and Petrov, 2002, 86, 88).

The blanket targeting of a wide cross-section of social groups and arbitrary victimization of individuals within those groups created a perception that repression was random. When asked how authorities decide whom to incarcerate or release, one NKVD officer explained, "Chance. People are always trying to explain things by fixed laws. When you've looked behind the scenes as I have, you know that blind chance rules a man's life in this country of ours" (Conquest, 2008, 434).

After the German invasion on June 22, 1941, the Soviet Union mobilized all military-age males – over 30 million civilians throughout the war – to support its 4.5 million-strong standing Red Army. These ordinary citizens were the backbone of the Soviet defense against the Germans. The war became an "acid test" for Stalinism: would the people risk their lives for a regime that only recently had terrorized them (Thurston, 2000)?

In some respects, Stalinism passed the test: millions of soldiers fought for the Soviet state, often to death. Early on, the Red Army stumbled spectacularly due

[4] State Archive of Russian Federation (GARF), collection 9401, series 2, case 450, pp. 30-37.

to prewar officer purges, politicized decision-making, and chronic mismanagement (Glantz, 2005). Ultimately, the Soviet Union won the war, and it did so largely by keeping its troops fighting *despite* organizational malaise and human loss (Reese, 2011). Yet many soldiers voted against Stalinism with their feet. This was the "first war fought by Russia in which a large force of its citizens joined the other side" (Conquest, 2008, 456). Half of all personnel losses in the war's first year comprised soldiers missing in action or captured. Thousands were detained for desertion, sabotage, or treason. While there were many reasons to shirk, widespread distaste for how the state treated its citizens did not help (Edele, 2017).

Moscow took draconian measures to hold its troops in line. On August 16, 1941, the Headquarters of the Supreme High Command issued Order 270, stipulating that those "who surrender to the enemy shall be considered malicious deserters, whose families could be arrested" (Zolotarev, 1997, 58-60). Commanders were to prepare bi-weekly reports for the General Staff, listing captured soldiers and their families' addresses (Kachuk, 2013). Among the victims of this order was Stalin's own son, Yakov, whose wife was sent to a labor camp after his capture by the Germans. People's Commissar of Defense Order 227 (July 28, 1942) went further, requiring all fronts to organize "penal units" staffed by men accused of indiscipline, and send them to the most dangerous sectors to "atone for crimes against the Motherland with their blood" (Statiev, 2010, 726). The order also mandated the creation of "blocking units" to detain or execute retreating personnel.

Given these punitive measures, soldiers who fought instead of fleeing might have done so because they were intrinsically committed to the cause or because they feared punishment. Soldiers who witnessed state repression prior to war may have been especially sensitive to these coercive incentives. They may also have been less eager to defend the regime in the first place. To assess how these countervailing pressures affected battlefield choices, we must consider how these citizen-soldiers actually fought.

III. Data and Measures

A. *Military records*

We extracted military records from a database maintained by the Russian Ministry of Defense, People's Memory (*Pamyat' Naroda*), which contains 106 million declassified Red Army personnel records. This includes 21 million records on irrecoverable losses and discharges, 23 million records from military transit points, 10 million registration cards, 1.3 million POW records, 5 million burial and exhumation records, 27 million decoration records, and 425,000 combat logs and staff documents. Aside from basic biographical information, these data record combat unit details (recruiting station, enlistment date, unit, rank), decorations, and the reason and date of the soldier's discharge.

Due to illegible handwriting, digitization inaccuracies, abbreviations, misspellings, incomplete or missing fields and other errors that are inevitable in archival data, these records required significant preprocessing. This included, among other things, homogenizing military ranks, unit names and numbers, assigning tactical units to parent divisions, corps, and armies, and standardizing and validating geographic names. Since the records do not contain a field like "social security number" that uniquely identifies soldiers across different sets of documents, we used a probabilistic record linkage approach (Enamorado, Fifield and Imai, 2019) which we tailored to be operable with our data (see Appendix A2).

Because we measure soldiers' exposure to repression based on their birth locations (see below), we excluded soldiers whose birthplaces were missing or could not be geocoded to the municipality level or lower. In our main analysis, we only include soldiers born within Soviet Russia (RSFSR), because data on arrest records — from which we construct our main independent variable — are sparse and less reliable outside RSFR.[5] Our final dataset contains 26,542,786 records for 11,606,552 soldiers.

B. Measuring combat resolve

Before the war ended, 46% of soldiers were discharged from the Red Army. Discharge categories included: killed or wounded in action (KIA/WIA), missing in action (MIA), prisoner of war (POW), deserted, defected or committed treason (DDT), or punished for misconduct (PUN). 17% of soldiers received medals for valor. As noted earlier, we use KIA/WIA as a proxy for compliance with orders, in the sense that a soldier fought until they exited the sample by being physically incapacitated (cf. Ager, Bursztyn and Voth, 2022).[6] We treat MIA, POW, DDT, or PUN as indicators of low combat resolve (cf. Costa and Kahn, 2003), and medals as indicators of high resolve (cf. Barber IV and Miller, 2019).

There are important caveats to consider when inferring soldiers' resolve from official wartime records. While it is quite plausible that soldiers who defected, deserted, committed treason (DDT) or were punished for misconduct (PUN) displayed low resolve by conventional standards, it is less clear whether becoming a POW is also evidence of shirking. Indeed, many soldiers surrendered en masse, sometimes on the orders of commanders. In the Soviet system, however, orders to surrender were illegal and soldiers were instructed to disobey them, even if they lacked the physical means to resist capture. Stalin's Order 270, which equated surrender with treason, stipulated that "every soldier is obligated ... to demand that their superiors fight to the end if part of their unit is surrounded."

Another caveat relates to MIA as a measure of shirking. Although this approach is consistent with past literature (Costa and Kahn, 2003), it may appear problematic because some of the unaccounted soldiers surely died fighting. Our

[5] The data on arrest records come from a Russia-based NGO, *Memorial*, and it naturally has better coverage for Russia compared to other former Soviet republics. In Appendix A7.10, we replicate our analysis with an expanded sample, which includes soldiers born in Soviet Ukraine in pre-1939 borders.

[6] We classify deaths in captivity as POWs, and executions as PUN.

interpretation is motivated by the fact that to avoid being held personally responsible, Soviet officers were notoriously reluctant to report unaccounted soldiers as DDTs or POWs. Instead, common wartime practice was to report them as MIA, as a Russian Defense Ministry official acknowledged:

> By official reports, out of our five million-plus missing in action, just 100 thousand were reported as prisoners of war. In reality, there were 4.5 million. So the majority of those missing in action were prisoners of war. Everyone knew this. I'm certain that even Stalin knew.[7]

The fact that some missing soldiers might have been KIA leads to a measurement error that should attenuate our estimates. We do not expect this error to be very large, since the quoted numbers suggest that $\Pr(\text{POW}|\text{MIA}) = 4.5\text{M}/5\text{M} = 0.9$.[8]

Finally, one should be careful when using military decorations as indicators of high resolve. Soldiers could be decorated (or denied decoration) for reasons unrelated to performance, like perceived political loyalty or ethnic discrimination. We therefore focus on a subset of awards — Medals "For Courage", "For Battle Merit", Order of Glory, and Hero of the Soviet Union — that specifically recognized individual performance in situations involving a risk to life, and which required detailed descriptions of individual acts (see Appendix A3 for examples).[9] Our estimations also control for observable factors like ethnicity and soldier's region of origin, which commanders could have used to infer one's perceived political loyalty when deciding whether to recommend them for an award.

Ultimately, our measures of combat resolve are valid only if they correlate in a predictable fashion with military units' aggregate performance. To establish this, we constructed an aggregate panel dataset with monthly observations for each major Soviet combat unit. Using monthly orders-of-battle from secondary sources (Fes'kov, Kalashnikov and Golikov, 2003), we matched combat units to soldiers by unit assignment and discharge date.[10] The result was an unbalanced panel dataset of 56,225 unit-month observations, tracking 5,756 active combat units over 48 months from June 1941 to May 1945.

Using official descriptions of 225 major battles from the People's Memory database, we classified each battle as resulting in a territorial gain, loss, or no change for Soviet forces (see Appendix A4 for details), and added these battles to the panel dataset. Because these were large, army-level operations, linking battles to units required establishing the "parent" army for each corps, division, regiment, and battalion in our monthly panel, and filtering soldiers' records to

[7] https://www.newsru.com/russia/04feb2011/stalin.html

[8] According to more conservative numbers from Krivosheev (1997), of 4.6M designated MIAs, 0.5M were "true" MIA's, 1M returned to the front, and 3.1M were POWs, implying $\Pr(\text{POW}|\text{MIA}) = 0.67$.

[9] We exclude career service awards and hybrid medals like the Order of the Patriotic War, which was awarded on both an individual basis and collectively to units, towns, factories and categories of veterans.

[10] These combat units correspond to the "operational-tactical" tier in Soviet military organization (Grechko, 1976), and include corps (6%), divisions (19%), brigades (19%), regiments (42%), battalions (9%), and other large formations under direct army command (5%). 7,531,315 soldiers (65% of probabilistically linked records) had information on both unit assignment and discharge dates.

include only those corresponding to the unit at the time of the battle.[11] For each unit-month, we calculated monthly proportions of soldiers who were KIA/WIA, MIA, POW, DDT, PUN, or received one of the four valor decorations.

Using this panel, we estimate a regression where the dependent variable is a dummy equal to one if the battle resulted in territorial gain and no loss, and the covariates are unit-month proportions of soldiers' battlefield outcomes. We include fixed effects for units, years, and months, to remove confounding due to unit-level and temporal factors. The results, in Table 1, show that the aggregate success of army units correlated positively with higher casualty rates and higher rates of medals, and negatively with all measures of shirking — MIA, POW, DDT, and PUN. Since any reasonable measure of combat resolve should be correlated with higher operational effectiveness, this suggests that our proxy measures correctly capture this latent quantity. In section VII, we exploit this correlation structure further to build a scalar index of combat resolve.

Table 1—Observable Battlefield Outcomes and Army Unit Performance.

Predictor	Coefficient (S.E.)	Implied correlation with combat resolve
Panel A.		
KIA/WIA	0.1 (0.1)	Positive: KIA → high resolve
Panel B.		
MIA	-0.3 (0.1)	
POW	-0.6 (0.2)	Negative: MIA/POW/DDT/PUN → low resolve
DDT	-1.9 (0.3)	
PUN	-1.1 (0.5)	
Panel C.		
Medals	0.2 (0.1)	Positive: Medal → high resolve

Note: OLS coefficients from linear probability regression: dependent variable is one if Red Army gained territory, zero otherwise. Unit of analysis is military unit by month (N = 27,368). Predictors measured as proportions per unit-month. Model includes fixed effects for units, years, months. Standard errors clustered by unit, battle. Observations weighted by number of soldiers.

C. *Data on repression*

Our data on repression come from the Victims of Political Terror archive, maintained by the Russian human rights organization Memorial. It draws on declassified case files from Russian federal and regional archives, the Commission for the Rehabilitation of Victims of Political Repression, regional NGOs, and "Memory Books." The 2,747,582 Memorial records do not include victims of famines, de-

[11] We were able to match 27,368 of the unit-months (49%) to at least one of the 225 battles.

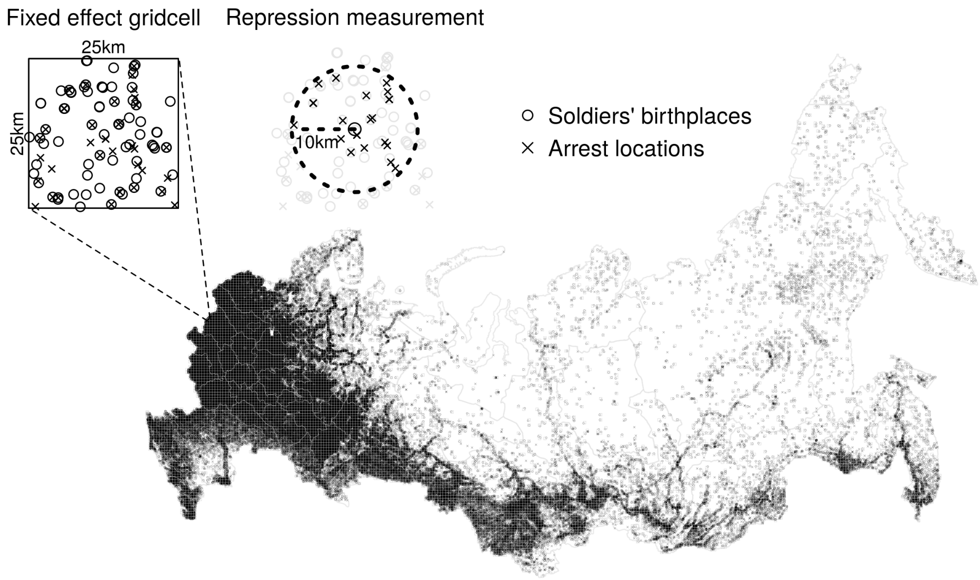

Figure 2. Geographic Distribution of Soldiers' Birthplaces and Exposure to Repression.

portations, and counterinsurgency operations, which were largely concentrated in the national republics outside Russia. Due to the under-representation of former Soviet republics other than Russia in Memorial, we limited our geographic scope to the RSFSR in its 1937 borders.[12] Using the same approach as with military data, we found geographic coordinates for 2.15 million pre-WWII arrests (78%), using victims' residential addresses (where available) or birthplaces.

As Figure 2 illustrates, we measure exposure to repression by counting the number of arrests in the vicinity of a soldier's birth location:

$$\text{Repression} = \log(1 + \text{Arrests within 10 km of birth location}),$$

where the logarithmic transformation is used to reduce skewness.[13] This geographic measure of repression rests on the idea that people are more aware of arrests in their home communities than in more distant locations. With the exception of elite show trials, political repression against ordinary citizens was not publicized, and people learned about the actions of the state mostly through family, neighbors, friends, or co-workers.

One concern in using birth locations is that some soldiers may have moved away before repression occurred. We can take stock of this issue by examining

[12] See Appendix A7.10 for a pooled analysis of Soviet Russia and Ukraine.
[13] Analyses with alternative bandwidths (1-20km) do not produce major differences (Appendix A7.6).

the distribution of travel distances between birth locations and the 1,869 military commissariats (*voenkomaty*) where soldiers were drafted. 18% of soldiers were born within 1 km of their draft location, 23% within 10 km, 53% within 100 km. 29% of soldiers were drafted by the *voenkomat* closest to where they were born. If most soldiers remained in their areas of birth until mobilization, they were likely also there in the 1930s.

We use absolute rather than per capita numbers of arrests because this is how narratives about state violence are typically framed and memorialized. 60 arrests (our sample median) from a town of 1,000 are unlikely to be perceived as two times more "repressive" than from a town of 2,000. Soviet state security records, historical and autobiographical narratives measure the scale of repression exclusively in absolute numbers.

At the same time, we must ensure that our measures of repression are not conflated with local population density. The Soviet pre-war censuses do not provide information on population counts below the district level.[14] In the analyses below, we adjust for several proxies of local population density (distance to the administrative center, road junctions, and farmland). In addition, we implement a matched cluster sampling design that selects pairs of locations that are as similar to each other as possible on observables, including the number of soldiers drafted as a proxy for local population size. Most conservatively, we replicate our results at an aggregate, district level, directly controlling for local population size and urbanization from the 1926 census.

D. Additional data

We collected additional data on historical political economy, logistics and ethnicity. To measure local state capacity, we use the distance in 1935 from each birthplace to the nearest district administrative center, where local NKVD branches were based (TsIK, 1935). To distinguish between urban and rural areas, we calculated hectares of cropland within 10km of each birthplace, using geo-referenced maps of economic activity from the 1937 *Large Soviet Atlas of the World* (Gorkin et al., 1937, 155). To account for the targeting of peasants during collectivization, we calculated the number of state farms within 10km of each birthplace (Gorkin et al., 1937, 161). We also georeferenced information on historical road and railway junctions (Afonina, 1996), to help capture local economic development.

With few exceptions, the military records do not include information on soldiers' ethnicity. Because national minority status could confound the relationship between pre-war repression and wartime behavior, we address this issue by building a nationality classifier for soldiers' surnames. Using the Memorial archive, which contains nationality information for 916,675 arrestees with 163,284 unique surnames, we trained a Support Vector Machine (SVM) classifier to predict (with

[14] District-level geographic precision allows us to estimate population counts for small areas (e.g. grid cells, see footnote 17), but not point estimates for specific birth locations.

97% out-of-sample accuracy) whether a surname's represents Russian nationality. We then assigned to each military personnel record a dummy variable equal to one if the surname's predicted nationality is Russian.[15]

IV. Empirical Approaches

A. *Ordinary Least Squares with Grid Cell Fixed Effects*

Our first empirical strategy is motivated by the observation that Stalin's terror was locally arbitrary in its selection of targets, net of group-level factors. We can treat exposure to repression as plausibly exogenous conditional on the observables that the regime used in selecting victims. One such observable was ethnicity: authorities often viewed minorities as politically disloyal and subjected them to greater coercion. Another was socio-economic: the regime saw *kulaks* ("rich" peasants) as an obstacle to collectivization, but defined "kulak" so loosely that most rural residents faced a heightened risk of coercion. A third was geographic: western borderland regions, the Far East, and areas with a history of peasant uprisings faced higher arrest quotas (Getty and Naumov, 1999).

Let y_i denote a battlefield outcome for soldier i and let $\text{Repression}_{j[i]}$ denote repression around the birth location j of soldier i. We fit the following OLS regression:

$$y_i = \gamma \cdot \text{Repression}_{j[i]} + \boldsymbol{\beta}'\boldsymbol{X}_{ij} + s\big(\text{lon}_{j[i]}, \text{lat}_{j[i]}\big) + \text{Cell}_{k[i]} + \epsilon_i. \tag{3}$$

The vector $\boldsymbol{X}_{ij}$ contains individual-level covariates (ethnicity and year of birth) as well as location-level covariates, including hectares of cropland and the number of state farms within 10 km of soldier's birth location, and distances to the nearest administrative district center and nearest road junction. The term $s(lon, lat)$ represents a two-dimensional spatial spline, which we include to capture local geographic trends.

To account for higher targeting of certain administrative regions (*oblasts*), it would suffice to include fixed regional effects. But even within-regional comparisons would involve locations that potentially differ on unobserved background characteristics. To ensure more balanced comparisons, we partition 1937 Soviet Russia's administrative regions into a regular 25×25km grid (shown on Figure 2), and include a fixed effect for the grid cell k in which soldier i was born. Because proximate locations tend to share background characteristics like population density, ethnic and socio-economic composition, these small area fixed effects should

[15] For surnames that do not appear in the training data, we assigned the predicted nationality of the surname that is closest in Jarro-Winkler string distance. We compared oblast-level proportions of Russians against census data from 1939. Wilcoxian rank-sum tests suggest that our SVM-classified oblast-level proportions were drawn from the same distribution as oblast-level census proportions (Appendix A5).

balance the unmeasured confounders. They also ensure that our inferences are drawn by comparing birthplaces no more than $\sqrt{25^2 + 25^2} \approx 35$km apart.[16]

The underlying assumption behind this design is that exposure to repression is *locally* exogenous. We evaluate this assumption by testing whether the geographic distribution of arrest locations within grid cells was spatially random. Within each 25×25 km cell, we tested the null hypothesis that arrest locations are the realization of a uniform Poisson point process. We were unable to reject this hypothesis in 87-96% of cells, depending on the test procedure (Appendix A6). Although arrest density varies between cells and regions, the *local* (within-cell) spatial distribution of repression appears quite arbitrary.

B. *Geographic discontinuities*

Our second empirical strategy utilizes the fact that regional state security officials had discretion when implementing central orders. A town located in a region run by a zealous state security chief could face more repression than a nearby town from a different region with less ambitious or cruel security officials. These discontinuities across regional borders can serve as a plausibly exogenous source of variation in repression levels.

The idiosyncratic qualities of local security personnel cannot be measured directly, but we can infer them indirectly by identifying administrative regions (*oblasti*) where repression was lower or higher than expected, conditional on observables. We first estimate how much the level of repression in each region deviated from what would be expected given basic observables like local population and urbanization. We do so using regression

$$\text{Repression}_j = \alpha + \beta_1 \cdot \ln\Big(\text{Population}_{k[j]}\Big) + \beta_2 \cdot \text{Urbanization}_{k[j]} + \epsilon_{kj}, \tag{4}$$

where j indexes birth locations and k indexes grid cells.[17] From the above regression, we calculate the average residual $\overline{\epsilon}_r$ for each region r. We then select pairs of adjacent regions (r, r') where the absolute difference between average residuals $\overline{\epsilon}_r$ and $\overline{\epsilon}'_r$ is at least one standard deviation; that is, we select adjacent regions with highly contrasting levels of repression that cannot be explained by their basic background characteristics.

Let d_{jr} denote the distance from birth location j in the region r to the border

[16] The median (maximum) distance between two birth locations in a grid cell is 8.9 km (16.9 km).

[17] Data on population and urbanization come from the 1926 Soviet Census, which reports them at the level of district (*rayon*). To disaggregate these data to smaller grid cells, we used dasymetric spatial interpolation, which employs ancillary data to obtain filtered area-weighted local estimates (Mennis, 2003). We used historical land cover maps (Gorkin et al., 1937) to exclude uninhabitable areas (water, deserts, glaciers) and distinguish built-up and rural areas.

of the nearest region. Define the forcing variable

$$\delta_{jr} = \begin{cases} d_{jr} & \text{if } \bar{\epsilon}_r > \bar{\epsilon}'_r, \\ -d_{jr} & \text{otherwise.} \end{cases}$$

To see how this forcing variable works, suppose that $\delta_{jr} = -2$. This means that birthplace j is inside a (relatively) low-repression region two kilometers away from a high-repression region. Had the administrative border between regions r and r' curved slightly differently to include j in r' instead of r, the level of repression in j would have been higher, in expectation. This is a plausible counterfactual: just prior to the Great Terror, Soviet regions underwent a series of territorial reforms, which subdivided large regions into smaller, more "manageable" units (Shiryaev, 2011). To preclude comparisons of wildly different locations, we restrict this analysis to birthplaces within ±50 km of regional borders.[18]

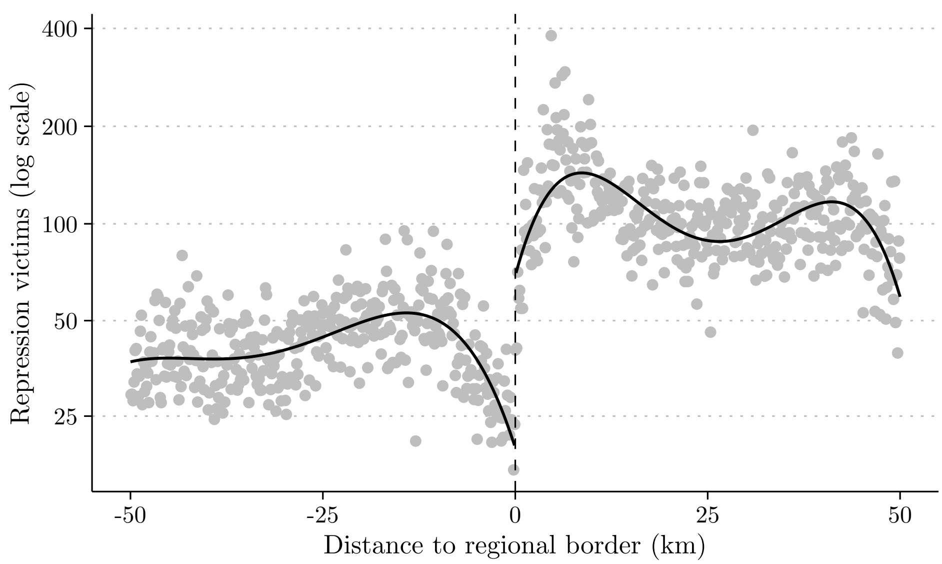

Figure 3. Discontinuity of Repression at Regional Borders (local means and polynomial fit).

Figure 3 plots the average levels of repression as a function of the forcing variable δ_{jr}. We see a discontinuous jump in repression levels as we move from less repressive to more repressive regions. The bias-corrected local-polynomial estimate of the discontinuity effect (Calonico, Cattaneo and Titiunik, 2015) is 0.85 (S.E. clustered by grid cells is 0.33) on the logarithmic scale. On the natural scale, estimated at the sample average, the effect is about 47 victims, as can be

[18]Appendix A6 reports a map of locations that are included in the regression discontinuity analysis.

seen in Figure 3.

An important concern with this design is that other things might change discontinuously across borders. To assess the magnitude of this problem, we conduct a series of balance tests reported in Figure 4. It shows the estimated discontinuity effects of eight variables, normalized to have a standard deviation of one for comparability. Only repression shows a discontinuous jump, suggesting that border discontinuities are not capturing differences in any observables other than repression. However, this does not rule out the possibility that the borders affected other relevant variables that we cannot measure.

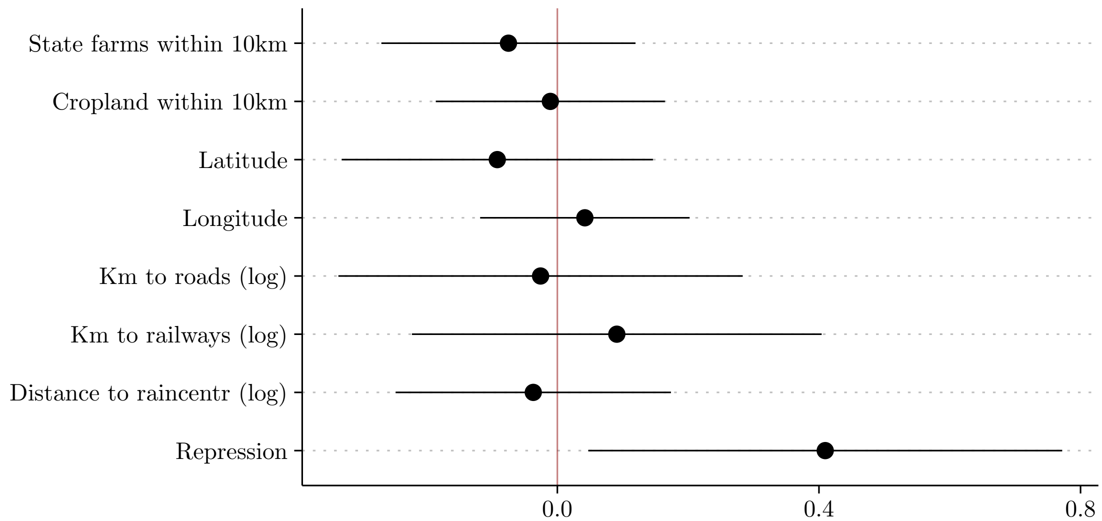

Figure 4. Balance Tests for Discontinuity at the Border.

Note: RD coefficients with 95% confidence intervals adjusted for clustering by grid cell. All outcomes are normalized for comparability.

With the latter caveat in mind, we exploit the border effects in a fuzzy regression discontinuity design (FRDD) using two-stage least squares:

$$(5)\quad \begin{aligned} \text{Repression}_{j[i]} &= \alpha \cdot \mathbb{1}\{\delta_{jr[i]} > 0\} + g_1\big(\delta_{jr[i]}\big) + \boldsymbol{\beta}'\boldsymbol{X}_{ij} + s(\text{lon}_j, \text{lat}_j) + \epsilon_{1i}, \\ y_i &= \gamma \cdot \widehat{\text{Repression}}_{j[i]} + g_2\big(\delta_{jr[i]}\big) + \boldsymbol{\beta}'\boldsymbol{X}_{ij} + s(\text{lon}_j, \text{lat}_j) + \epsilon_{2i}, \end{aligned}$$

where g_1 and g_2 are smooth functions of forcing variable δ_{jr} estimated using regression splines, and indicator $\mathbb{1}\{\delta_{jr} > 0\}$ is the instrument for repression. Both stages include covariates and spatial splines but exclude grid cell fixed effects — because cells are nested within regions, by construction, the instrument cannot vary within cells.

C. Clustering and Weights

The outcome variables in our study are measured at the level of individuals, but we observe exposure to repression at the level of birth locations. Due to the potential correlation of errors across individuals from the same location (cluster), the effective sample size is bound to be smaller than the number of individual soldiers in the data. To account for this correlation of errors, we cluster standard errors by birth location, which is the level at which the treatment varies. We also cluster standard errors by grid cells to account for spatial autocorrelation. Finally, to incorporate the uncertainty inherent in our procedure of classifying military records, we weigh soldiers by the geometric mean of pairwise matching propensities of records assigned to them (see Appendix A2).

V. Main Results

Table 2 reports estimated coefficients on repression ($\hat{\gamma}$) from fourteen regression models. For each of the seven battlefield outcomes, we report estimates from OLS with grid cell fixed effects, and FRDD with the border instrument. Estimates in the first row suggest that soldiers from places with more repression died or were wounded on the battlefield at higher rates. The conclusion is consistent across both designs. The 0.5 OLS coefficient implies that increasing repression in the soldier's birthplace within the same 25×25km grid cell from zero to 32 people (first quartile in sample) meant a $[\ln(32{+}1) - \ln(0{+}1)] \times 0.5 \approx 3.5 \times 0.5 = 1.8$ percentage point higher chance of death or injury, after adjusting for soldier-specific and location-specific covariates. Based on the FRDD estimate, the respective change is approximately $3.5 \times 1.8 = 6.3$ percentage points. Given that the mean KIA/WIA rate in the sample is about 21 percent, these magnitudes are substantial.

The next batch of outcomes represents soldiers' proclivity to shirk. The first outcome in this batch is an index *Flee*, indicating whether a soldier was reported as either missing, surrendered, deserted, defected, committed treason, or punished for misconduct. The coefficients on repression are negative for both OLS and FRDD but significant only at 90% confidence level after clustering standard errors by soldiers' birth location and grid cell. Substantively, the increase of repression from zero to the first quartile is associated with a reduced chance of shirking (flight) by 0.4 (3.5×-0.1) to 1.8 (3.5×-0.5) percentage points, depending on the specification. Coefficients for MIA, the most frequent flight indicator, are also consistently negative and significant at the 95% confidence level.

Estimates for the other individual indicators of shirking offer more mixed results, from negative for PUN to negative, null and inconsistently positive for POW and DDT. Some of this variability may reflect the idiosyncrasies of reporting. Most POW's, as we noted, were officially misreported as MIA's and cases of DDT were rare, raising the possibility that these outcomes emerged under qualitatively different circumstances. Notably, positive coefficients on POW and

Table 2—Coefficients on Repression for each Battlefield Outcome.

	Coefficient on Repression		
Outcome	OLS	FRDD	Mean outcome
Panel A.			
KIA/WIA	0.5 (0.1)	1.8 (0.6)	21.4
Panel B.			
Flee (index)	-0.1 (0.1)	-0.5 (0.3)	25.6
MIA	-0.1 (0.1)	-0.7 (0.2)	20.1
POW	-0.03 (0.04)	0.3 (0.2)	5.7
DDT	0.01 (0.002)	-0.002 (0.005)	0.2
PUN	-0.01 (0.005)	-0.04 (0.02)	0.8
Panel C.			
Medals	-0.2 (0.1)	-0.9 (0.3)	17.9
Birthplaces	180,895	38,521	
Gridcells	12,176	2,094	
Soldiers	11,351,164	2,828,431	

Note: Outcomes are on a percentage scale (0 to 100): killed or wounded in action (KIA/WIA), missing in action (MIA), prisoner of war (POW), defected, deserted, or committed treason (DDT), punished for battlefield misconduct (PUN), any of the last four (Flee), and receiving at least one valor decoration (Medal). Standard errors in parentheses, clustered by birth location and grid cell. All regressions include grid cell fixed effects, and individual and birth location-level covariates. Observations weighted by record clustering probability. FRDD excludes locations in non-matched regions and $>$ 50km from regional borders. FRDD first-stage $F = 13.6$.

DDT do not survive robustness tests, but coefficients for MIA and PUN remain negative and significant in most specifications (Appendix A7.4).

The final row in Table 2 reports the estimated effects of repression on battlefield initiative, measured through a soldier's receiving at least one decoration for valor (*Medals*). The estimated coefficients are negative and significant at the 99% level of confidence. In substantive terms, increasing repression from zero to the first quartile is associated with 0.7 (3.5×-0.2) or 3.1 (3.5×-0.9) percentage point lower probability of a medal, in OLS and FRDD models, respectively. These magnitudes are substantial, given that 18 percent of soldiers received such awards.

VI. Caveats and Robustness Checks

Some of the FRDD estimates are larger than OLS estimates, which may be concerning. This could be the artifact of FRDD analyses using a different sample than OLS: locations within 50km of matched borders. However, OLS coefficients are nearly identical if we restrict the OLS sample in the same way as FRDD

(Appendix A7.7). A second explanation is that OLS estimates may be attenuated due to errors in the measurement of repression. As the instrument should alleviate attenuation bias, the larger FRDD estimates make sense.

A more fundamental consideration is that the estimates diverge because they represent different quantities. Under the design assumptions, FRDD estimates represent the local average treatment effect of repression induced by proximity to regional borders. Repression induced by exogenous factors, like border discontinuities, may have appeared more arbitrary and, as such, had a stronger overall impression on those who were exposed to it.

Finally, and most importantly, we cannot directly rule out the possibility that differences in coefficient size are due to violations of the exclusion restriction. The same idiosyncratic factors that led to higher arrest rates across regional borders could also have led to differential battlefield outcomes through channels other than repression. More zealous local administrators could have been more efficient in drafting soldiers and transporting them to the front in the early stages of the war, when death rates were high. They may also have had a better capacity to keep records of these soldiers. The evidence for these alternative pathways is weak, however. In additional analyses (Appendix A6), we find no discontinuous border effect on the timing at which soldiers started or terminated their service. We do find that soldiers in higher-repression border regions were slightly less likely to have missing discharge records, but there is little evidence that such missingness is consequential for our findings (see below). While partly reassuring, these results do not rule out the possibility of other violations of the exclusion restriction.

We conducted a battery of robustness tests (Appendix A7). One well-known problem with clustered treatment designs is bias due to unequal cluster size. In our case, because higher-population areas may, mechanically, see higher absolute numbers of arrests, the treatment level is correlated with cluster size. To evaluate these biases, we adopt a matched cluster sample design (Imai et al., 2009), sampling pairs of birthplaces that are similar on observable pre-treatment covariates, are from the same grid cell and in the same quintile of cluster size. The procedure yields a matched sample of 41,274 clusters (22% of total), or 20,637 matched pairs (Appendix A7.1). We ran our analyses on the subset of soldiers who were born in these matched clusters. To further account for local population size, we averaged individual outcomes at the level of birthplace and ran the same regressions on these aggregated data, using full and matched samples. We did the same at the level of districts ($N = 361$), directly controlling for local population size and urbanization from the 1926 census. Table 3 reports estimates from these reanalyses of alternative samples and units of analysis, which are consistent in sign and significance with those in Table 2.

We also considered the possibility that our results are biased due to incompletely observed records. We observe discharge records for 46% of soldiers, and our analyses assumed that soldiers without such records continued their service until war's end. Our conclusions remain robust when we exclude individuals whose

Table 3—Alternative Samples and Units of Analysis.

	KIA/WIA	Flee	Medals
Panel A.			
Units of analysis	Soldiers (matched clusters), $N = 4{,}489{,}873$		
Coef. for Repression	0.5 (0.1)	-0.2 (0.1)	-0.4 (0.1)
Panel B.			
Units of analysis	Soldiers' birthplaces, $N = 180{,}895$		
Coef. for Repression	0.6 (0.1)	-0.2 (0.1)	-0.2 (0.04)
Panel C.			
Units of analysis	Soldiers' birthplaces (matched clusters), $N = 41{,}272$		
Coef. for Repression	0.6 (0.1)	-0.1 (0.1)	-0.3 (0.1)
Panel D.			
Units of analysis	Soldiers' districts, $N = 336$		
Coef. for Repression	1.3 (0.4)	-0.6 (0.4)	-0.6 (0.2)

Note: Outcomes on percentage scale. Clustered standard errors in parentheses. First set of models includes grid cell fixed effects, individual and birth location-level covariates. Second and third inlcude grid cell fixed effects, birth location-level covariates, and birth location-level averages of individual-level covariates. Fourth includes regional fixed effects and district averages of individual and birth location-level covariates. Observations weighted by record clustering probability (1) or number of soldiers (2-4).

discharge reasons are not observed (Appendix A7.2). Our results also hold when we consider a more selective set of medals (Appendix A7.3), when we consider only the subset of soldiers who did not flee, and when we separate out soldiers who received medals posthumously (Appendix A7.5).

Our analysis treats battlefield outcomes as independent across individual soldiers, although in reality soldiers do not make decisions in isolation. Following the econometric approach of Carrell, Sacerdote and West (2013) for the study of peer effects, we account for the interdependence of soldier-level outcomes within army units (Appendix A7.8). The estimates are consistent with our main results. These additional results indicate that repression may have impacted soldiers' behavior not only directly, but also indirectly, through the behavior of their peers.

As an additional robustness check on our identification strategy, we exploit exogenous variation in repression due to the logistical costs of accessing and transporting arrestees to prison colonies by railroad. The estimates based on this alternative instrument align with those we report here (Appendix A7.9).

Finally, because limiting our analysis to soldiers born inside Russia risks missing a large part of the story, we expanded the sample to include soldiers born in Ukraine — the USSR's second-most populous republic. Our conclusions remain unchanged after running our models on this expanded sample (Appendix A7.10).

VII. Distributional Test Using a Combat Resolve Index

So far we have tested our theoretical predictions using individual-level outcomes as indirect measures of combat resolve, which was in part justified by the specific correlation structure between the individual-level outcomes and the battlefield success (Table 1). We now exploit these correlations further by constructing a scalar index of combat resolve for each unit-month, to conduct a more direct, distributional test of our predictions.

Building on the results in Table 1, we first estimate a semiparametric regression

$$\text{Territorial gain}_{it} = \sum_k f_k(y_{itk}) + \epsilon_{it},$$

where the outcome variable is equal to one if the battle in which unit i took part at time t resulted in territorial gain and y_{itk} is the proportion of soldiers in unit i and year-month t with the outcome $k \in \{\text{KIA/WIA, MIA, POW, DDT, PUN, Medal}\}$. f_k is a smooth function for input k, approximated by cubic regression splines.

The combat resolve index (CRI) for unit i in year-month t is the predicted probability that a unit participated in a successful battle, conditional on the proportion of its service members who experienced each of these battlefield outcomes:

$$\text{CRI}_{it} = \sum_k \hat{f}_k(y_{itk}),$$

where $\hat{f}_k$ is the estimated function. By Proposition 1, CRI should have a higher mean *and* lower variance when a unit comprises soldiers with higher average exposure to repression.

We residualize CRI and repression measures by regressing each of them on fixed effects for units, years, and months, and the covariates used in soldier-level regressions (averaged over unit-months). Figure 5 shows the kernel density estimates of residualized CRI for units with repression levels above and below the residualized sample average. The mean CRI in units with "above average repression" is 0.06 standard deviations higher than in units with "below average repression." The difference is statistically significant at the 95% level after accounting for the clustering of standard errors by unit and battle (S.E. = 0.02). Consistent with Proposition 1, *average* combat resolve increases in repression.

Figure 5 also shows that, in units where more soldiers were exposed to repression, the distribution of CRI is compressed from both sides toward the center. This is consistent with the prediction that repression decreases the variance of combat resolve. The empirical patterns in Figure 5 broadly resemble the the-

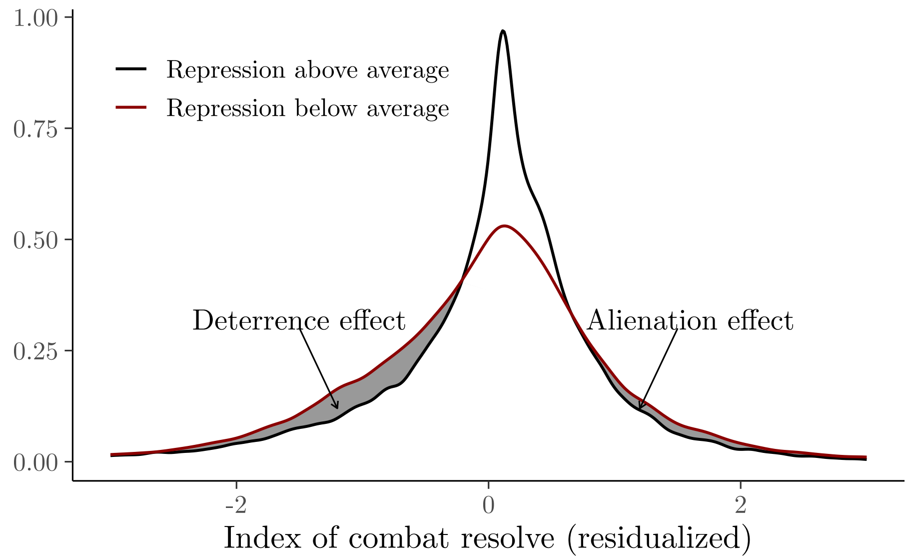

FIGURE 5. DENSITY ESTIMATES OF CRI BY REPRESSION LEVELS.

oretical prediction shown in Figure 1. In units with more exposure to prewar repression, we observe a deterrent effect of low-level CRI being pushed up and an alienation effect where high-level CRI is pushed down.

We test the prediction about variance reduction more formally using conditional quantile regression. The dependent variable in this regression is the residualized CRI and the independent variable is residualized repression. Figure 6 shows estimated quantile regression coefficients for each decile of residualized CRI. The estimated coefficients are positive for the lower quantiles and negative for upper quantiles, consistent with the variance reduction hypothesis. Units with high average exposure to repression had higher CRI at the low end of the distribution and lower CRI at the high end of the distribution, compared to units with low average exposure to repression.

VIII. Interpretation

The above empirical patterns align closely with the logic of "perfunctory compliance." The fact that soldiers exposed to repression were more likely to die, less likely to flee, and less likely to receive awards for valor indicates that repression simultaneously increased extrinsic motivations to fight while sapping intrinsic ones. This evidence contradicts the view that repression uniformly incentivizes over- or under-performance (Edele, 2017). Rather, repression spurs higher performance by soldiers who would otherwise show low resolve and lower performance by soldiers

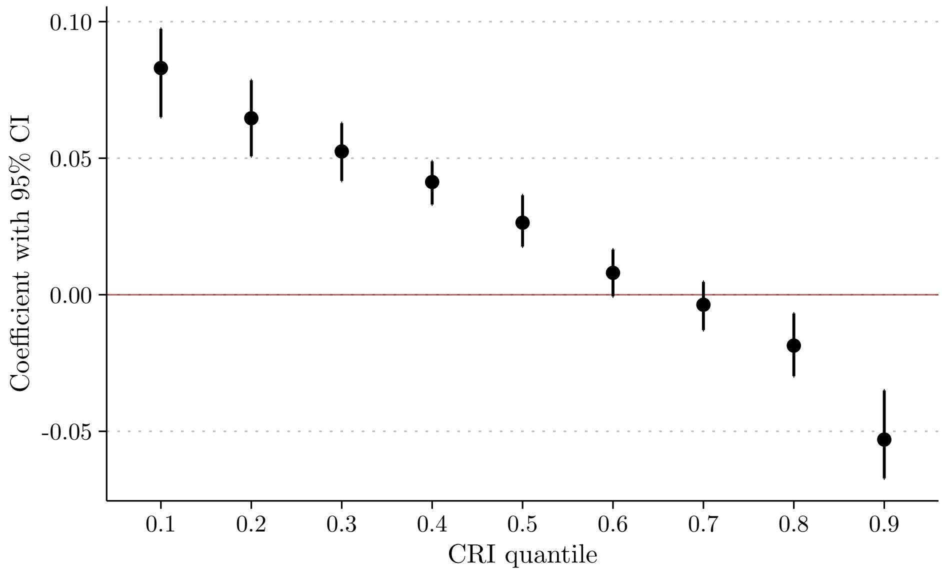

Figure 6. Quantile Regression Coefficients on Repression.

who would otherwise show high resolve.

The explanation that prewar terror conditioned soldiers into conformity resonates with historical accounts. As Merridale (2006, 45-46) writes, soldiers who witnessed the terror were "bound together by shared awe, shared faith and shared dread… It was far easier, as even the doubters found, to join the collective … than to remain alone, condemned to isolation and the fear of death." Glantz (2005, 446) notes that repression incentivized overly cautious decision-making and undermined independent thinking at all levels of the Red Army; those "who survived the terror were paralyzed [and] afraid to display initiative." As Overy (1998, 32) observes, "the result [of Stalin's terror] was the triumph of military illiteracy over military science, of political conformity over military initiative."

An important alternative interpretation of these results is that they reflect the differential treatment of soldiers by the state, rather than differential behavior by soldiers. The positive relationship between repression and combat deaths may exist because authorities used soldiers from heavily-repressed areas as "cannon fodder," with more dangerous assignments, worse equipment and leadership. The negative relationship with flight may suggest that authorities more closely monitored these soldiers, or sought to minimize their opportunities to cross the front line. The negative relationship between repression and medals may reflect unit commanders' hesitancy to recommend, and higher authorities' refusal to approve, decorations for soldiers from "problematic" parts of the country.

Some of these possibilities are more facially plausible than others. Because our treatment variable captures geographic exposure to repression, discrimination during a soldier's assignment to units would have required not only information about the soldier's personal history, but also about how many of the soldiers' neighbors the secret police had arrested. Military commissariats did not have this information — it was collected and closely guarded by a different agency — nor would they have had the time to process it at the height of war. While valor decorations required proper vetting of soldiers' backgrounds, enlistment was a fast-paced and haphazard process (Glantz, 2005, 470), which made this type of selective assignment difficult to implement consistently or at scale.

The same applies to possible discrimination of soldiers after they are assigned to units. As we document in Appendix A8, the Service Record Card Files available to unit commanders contained information on soldiers' families and political background, but no information on whether the soldiers in question were from "problematic" locations where many people had been arrested. Such information would be necessary for unit commanders to discriminate against individual soldiers on individual level (net of their other observable characteristics for which we control) by assigning them to more dangerous tasks or by monitoring them more closely to prevent shirking.

A discrimination interpretation of our findings for flight and medals is difficult to reconcile with other empirical patterns. To the extent that authorities sought to minimize exposed soldiers' opportunities for flight, the most direct means of doing so — assigning soldiers to rear duties — would run counter to the "cannon fodder" interpretation of our KIA/WIA results, since such assignments would also minimize soldiers' exposure to enemy fire. As regards medals, Table 2 shows that soldiers from high-repression locations were *not* more likely to be punished for real or presumed violations of military code, which is the opposite of what we should see if these soldiers were subject to more scrutiny.

We now consider these arguments more directly, and evaluate whether, instead of conformity, our empirical findings might reflect discrimination at the individual or unit level.

A. *Rank Advancement*

If soldiers from high-repression areas faced discrimination during the allocation of military awards, then it seems reasonable to expect them to have also suffered discrimination during promotions. Rank advancement decisions followed a structurally similar bureaucratic process to medals, but were more weakly tied to individual combat performance. Similar to medals, unit commanders would recommend individuals for promotion, with conferral authority residing with higher ministerial or party authorities (see Appendix A3). Unlike medals — where specific combat actions were the main consideration — criteria for promotion were more varied and included factors like length of service, the need to fill higher-ranking billets, ethnic or religious quotas, disciplinary records, party membership, and other indicators of political loyalty. Opportunities for discrimination to enter the promotion process were more abundant than in the conferral of medals.

Table 4—Repression, Promotions and Army Branch Assignment.

	Promotion	Infantry	Penal
Panel A.			
Model		OLS	
Coef. for Repression	0.01 (0.03)	-0.1 (0.1)	0.003 (0.004)
Mean Y	10.1	82.9	0.1
Birthplaces	158,154	116,204	116,204
Gridcells	10,944	9,580	9,580
Soldiers	6,951,642	2,342,735	2,342,735
Panel B.			
Model		FRDD (First-stage $F = 14.4$)	
Coef. for Repression	0.02 (0.1)	-0.4 (0.3)	0.02 (0.01)
Mean Y	10.1	82.2	0.1
Birthplaces	33,251	24,823	24,823
Gridcells	1,959	1,810	1,810
Soldiers	1,733,432	578,275	578,275

Note: Outcome = at least one advancement in rank (Promotion), assignment to infantry branch (Infantry) or penal unit (Penal), measured on percentage scale (0 to 100). Standard errors in parentheses, clustered by birth location and grid cell. Models include grid cell fixed effects, individual and birth location-level covariates. Observations weighted by record linkage probability. Rank information unavailable for 39% of soldiers. Branch information unavailable for 79% of soldiers. FRDD excludes locations in non-matched regions and > 50km from regional borders.

If discrimination drove our results on medals, we should see a similar negative effect for promotions. We re-estimate our baseline regressions with the outcome variable equal to one if a soldier advanced ranks at least once during the war, and zero otherwise. As the first column in Table 4 reports, we find no evidence that soldiers with higher exposure to repression were less likely to be promoted. Unless rank advancement was insulated from political considerations while the conferral of decorations was not (which seems implausible), discrimination does not appear to be a strong alternative to our explanation.

B. *Assignment to Army Branches*

Another mechanism through which discrimination could explain our results is that soldiers from repressed places died in larger numbers because they were selectively assigned to serve in more dangerous positions within the army. To assess this possibility, we check whether soldiers from highly repressed areas were more likely to be assigned to the infantry branch of the army — where direct exposure to enemy fire was higher than in other branches, like artillery and aviation — or to so-called "penal units," which were routinely ordered to charge through minefields and machine-gun fire.

Contrary to the "cannon fodder" hypothesis, the estimates in Table 4 (second column) suggest that conscripts from high-repression areas were *less* likely to serve in the infantry, although the result is significant only for OLS. There is mixed evidence of a positive correlation between prewar repression and assignment to penal units (third column). Even if we take the FRDD estimate at face value, its magnitude is small: a soldier from a location with 32 arrests (first quartile) was $3.5 \times 0.02 = 0.07$ percentage points more likely to serve in a penal unit than a soldier from a place with no arrests. Given that just 0.1% of soldiers in our sample were assigned to penal units during the war, this accounts for a small fraction of the estimated effect of repression on deaths and injuries. Our results on KIA/WIA are almost identical if we exclude soldiers assigned to penal units.[19]

C. Assignment to Combat Units

A third mechanism through which discrimination could explain our results for death rates operates at the level of combat units rather than army branches: soldiers from highly-repressed locations may have been selectively assigned to units with older equipment, less competent commanders, in more dangerous locations.

We can account for some of the variation by including fixed effects for the unit in which each soldier served and the time of their deployment in that unit. In the case of OLS, we augment the baseline regression to include fixed effects for combat units in which a soldier fought, and fixed effects for the month of the war, ranging from June 1941 to May 1945. The variable that indexes combat units has almost 12,000 unique values and identifies the smallest-echelon unit mentioned in each record.[20] Because 30% of soldiers had served in more than one unit, we disaggregated soldiers' records by unit assignment for this analysis.

Coefficient estimates remain similar to baseline specifications after we adjust for unit and time fixed effects (Table 5). Depending on the estimator, increasing repression from zero to the first quartile (32 arrests) increased one's chances of death or injury by 0.7 to 4.2 percentage points, decreased flight by 0.4 to 2.5 points, and chances of receiving a medal by 0.1 points (as before, percentage change $\approx 3.5\hat{\gamma}$). Although the medals result loses significance, the other estimates remain consistent with the logic of conformity, even when we compare soldiers serving concurrently within the same units, who thus fought in the same battles, under the same commanders, with the same comrades-in-arms.

As regards the quality of equipment, documents from Soviet military archives

[19]The OLS coefficient in the restricted sample is 0.47 (S.E. = 0.08), close to the estimate in Table 2.

[20] Among records with non-missing unit information, we traced 53% to a specific division, 10% to a brigade, 28% to a regiment, 2.4% to a battalion and 7.4% to a company.

TABLE 5—ESTIMATES ADJUSTING FOR MILITARY UNIT AND MONTH.

	KIA/WIA	Flee	Medal
Panel A.			
Model		OLS	
Coef. for Repression	0.2 (0.04)	-0.1 (0.03)	-0.02 (0.03)
Mean Y	40.3	19.2	8.3
Birthplaces	134,351	134,351	134,351
Gridcells	9,808	9,808	9,808
Soldiers	5,470,129	5,470,129	5,470,129
Panel B.			
Model		FRDD (First-stage $F = 18.1$)	
Coef. for Repression	1.2 (0.4)	-0.7 (0.2)	-0.03 (0.1)
Mean Y	51.9	20.9	7.6
Birthplaces	1,590	1,590	1,590
Gridcells	19,450	19,450	19,450
Soldiers	756,455	756,455	756,455

Note: Outcomes on percentage scale (0 to 100). Standard errors in parentheses, clustered by birth location and grid cell. All models include grid cell, unit and month fixed effects, individual and birth location-level covariates. Observations weighted by record linkage probability. Sample includes disaggregated personnel records, with non-missing unit and date information. FRDD analyses exclude locations in non-matched regions and $>$ 50km from regional borders.

reveal significant temporal variation in the supply of arms and ammunition across fronts — driven largely by industrial production, stockpiles, and the pressures of ongoing campaigns — but no evidence that authorities selectively withheld support from specific units on the basis of (average) pre-war repression levels (Appendix A8). The General Staff's monthly supply plans allocated resources across large formations like fronts and armies, but not operational-level units like divisions and regiments. If some units were nonetheless chronically undersupplied, our unit-level fixed effects should account for this variation. While we cannot rule out the possibility that discrimination existed within units at an individual level — net of age, ethnicity, and other observables — this would require that (a) unit commanders had information on prewar arrest levels near each soldier's birth location, and (b) commanders prioritized this information over subordinates' tactical needs when making decisions in battle, both of which are inconsistent with the qualitative evidence.

D. Wartime Learning

Additional evidence for the competing mechanisms underlying our results can be gained by examining how the relationship between pre-war repression and battlefield behavior changed over time. The incentive structure and the informational environment shifted substantially during the course of the war, due to increasingly harsh disciplinary measures within the Red Army and increasing awareness of German cruelty against Soviet civilians and captured soldiers. Depending on their exposure to pre-war repression, soldiers may have adjusted differently to this changing environment.

To examine temporal heterogeneity, we use our combat unit panel to estimate a regression where the coefficient on repression varies by month of the war:

$$y_{ut} = \text{Month}_t + \text{Unit}_u + \sum_t \gamma_t \cdot \text{Repression}_{ut} + \boldsymbol{\beta}' \mathbf{X}_{ut} + \epsilon_{ut}, \tag{6}$$

where y_{ut} is the percentage of a unit's soldiers that were KIA/WIA, fled (index), or received a medal at time $t \in \{\text{June 1941}, ..., \text{May 1945}\}$. Month_t and Unit_u are month and unit fixed effects. Repression_{ut} is the average exposure to repression in unit u and month t, and $\mathbf{X}_{ut}$ are the control variables from our baselines regressions, averaged by unit-month. Our quantities of interest are γ_t, the time-variant coefficients on repression for each of the three outcomes. As in the previous unit-level regressions, we weigh observations by the number of available records within each unit-month. We cluster standard errors by units.

Figure 7 shows the estimated coefficients with 95% confidence intervals for each of the three outcomes. With the understanding that one should be cautious in attributing temporal changes in coefficients to specific events, several patterns are worth noting.

The largest positive estimates for KIA/WIA and the largest negative estimates for Flee (late summer of 1942) both coincide with Stalin's issuance of Order No. 227 on July 1942, which outlawed "cowardice" and "panic." This change follows a similar negative turn in estimates for Flee following Stalin's Order No. 270 on August 1941, outlawing surrender. If such policies indeed drove these temporal shifts, this would indicate that soldiers exposed to pre-war repression were more sensitive to coercive incentives on the battlefield. These patterns could also reflect the higher responsiveness of repressed soldiers to reports about poor conditions in German POW camps, particularly in the second half of 1941.

Estimates for medals follow a different pattern, becoming more negative over time. This pattern reflects the fact that 90 percent of all valor decorations in the Red Army were for actions taken in the second half of the war, following the Battle of Kursk in July 1943. This battle was a key turning point in the war, marking Germany's final strategic offensive. As the Red Army began its long drive to Berlin, Soviet authorities sought to incentivize acts of bravery, by estab-

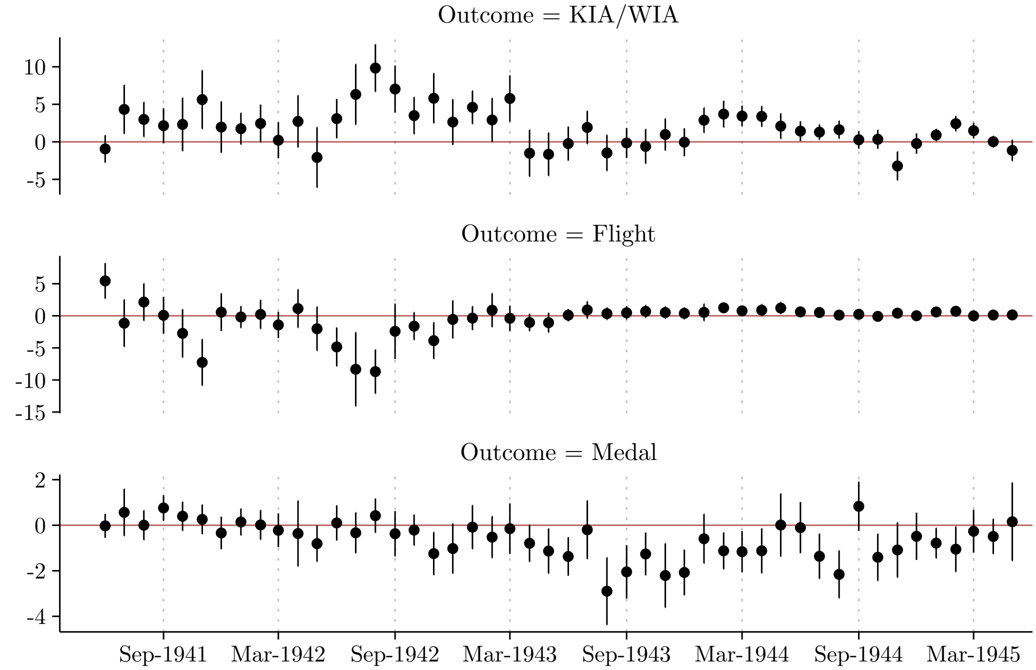

Figure 7. Time-variant Coefficients on Repression with 95% CI's.

lishing new decorations (e.g. Order of Glory in November 1943) and amending eligibility criteria for others (e.g. "For Courage" in June 1943). The fact that effect estimates remain strongly negative throughout this period — at a time when battlefield exploits were more likely to be recognized — suggests that soldiers from repressed areas were not only more responsive to coercive incentives (deterrence effect), but they were also less responsive to positive inducements (alienation effect).

IX. Conclusion

Our analysis of Red Army personnel records suggests that soldiers with greater exposure to Stalin's terror were more likely to fight to death or injury than to shirk by fleeing the battlefields of the Second World War. They were also less likely to show personal initiative in battle, as far as we can infer from military decorations. While we cannot fully exclude the possibility that unobserved factors are driving these relationships, our analyses suggest that the net effect of prewar repression was conformity. Soldiers from places with higher levels of repression obeyed orders and kept fighting not because repression turned them into zealots willing to go beyond their call of duty, but because they were more aware of what the state might do if they did not comply. Past repression may have compelled less-motivated soldiers to signal resolve, but it may also have decreased effort by highly-motivated types. The countervailing forces of deterrence and alienation helped resolve some principal-agent problems associated with fighting, but they did so by inculcating obedience at the expense of initiative, and raising the human costs of war.

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Online Appendix

Fighting for Tyranny: State Repression and Combat Motivation

Arturas Rozenas, Roya Talibova, and Yuri M. Zhukov

Contents

A1. Proof of Proposition 1

The expected risk is equal to

$$\begin{aligned}
\mathbb{E}_\omega(a^*(\omega,r)) &= \int_{-\infty}^{\infty} a^*(\omega,r)dF(\omega) \\
&= \int_{-\infty}^{\overline{a}+\alpha r} \frac{\omega+\delta r\overline{a}-\alpha r}{1+\delta r}dF(\omega) + \int_{\overline{a}+\alpha r}^{\infty} \omega - \alpha r dF(\omega) \\
&= \int_{-\infty}^{\overline{a}+\alpha r} \frac{\omega}{1+\delta r}dF(\omega) + \int_{\overline{a}-\alpha r}^{\infty} \omega dF(\omega) \\
&+ \int_{-\infty}^{\overline{a}+\alpha r} \frac{\delta r\overline{a}-\alpha r}{1+\delta r}dF(\omega) + \int_{\overline{a}+\alpha r}^{\infty} \alpha r dF(\omega) \\
&= \frac{\mathbb{E}(\omega)}{1+\delta r} + \frac{\delta r}{1+\delta r}\int_{\overline{a}+\alpha r}^{\infty} \omega dF(\omega) \\
&+ \frac{\delta r\overline{a}-\alpha r}{1+\delta r}F(\overline{a}+\alpha r) - \alpha r(1-F(\overline{a}+\alpha r)) \\
&= \frac{\mathbb{E}(\omega)}{1+\delta r} + \frac{\delta r}{1+\delta r}\left[\int_{\overline{a}+\alpha r}^{\infty} \omega dF(\omega) + F(\overline{a}+\alpha r)(\overline{a}+\alpha r)\right] - \alpha r.
\end{aligned}$$

Letting $z = \overline{a}+\alpha r$, we have

$$\begin{aligned}
\frac{\partial}{\partial r}\mathbb{E}(a^*(\omega,r)) &= -\frac{\delta\mathbb{E}(\omega)}{(1+\delta r)^2} + \frac{\delta}{(1+\delta r)^2}\left[\int_z^{\infty} \omega dF(\omega) + F(z)z\right] \\
&+ \frac{\delta r}{1+\delta r}\left[-f(z)z\alpha + \alpha F(z) + f(z)z\alpha\right] - \alpha \\
&= -\frac{\delta\mathbb{E}(\omega)}{(1+\delta r)^2} + \frac{\delta}{(1+\delta r)^2}\left[\int_z^{\infty} \omega dF(\omega) + F(z)z\right] + \frac{\delta r}{1+\delta r}\alpha F(z) - \alpha \\
&> -\frac{\delta\mathbb{E}(\omega)}{(1+\delta r)^2} + \frac{\delta z}{(1+\delta r)^2} + \frac{\delta r}{1+\delta r}\alpha F(z) - \alpha,
\end{aligned}$$

where the last inequality follows from the fact that $\int_z^{\infty} \omega dF(\omega) = \mathbb{E}(\omega|\omega > z)(1-F(z)) > z(1-(F(z))$. The above expression is positive if and only if

$$\overline{a} > g(r,\overline{a}) \equiv \frac{\alpha}{\delta}\left[(1-F(\overline{a}+\alpha r))(1+\delta r(1+\delta r))\right] + \mathbb{E}(w). \tag{1}$$

g is finite-valued, since $\lim_{r\to 0} g(r,\overline{a}) = \lim_{r\to\infty} g(r,\overline{a}) = 0$. Furthermore, g is decreasing in $\overline{a}$ (since F is increasing), and so for each r, there is an interior point $\hat{a}(r) = g(r,\hat{a}(r))$ such that $\overline{a} > g(r,\overline{a})$ if and only if $\overline{a} > \hat{a}(r)$. It follows that $\mathbb{E}_\omega(a^*(\omega,r))$ is everywhere increasing in r if and only if $\overline{a} > \max_r \hat{a}(r)$.

Since $\overline{a} > \underline{a}$, the probability that a soldier defects or surrenders is equal to

$$\begin{aligned}
\Pr(a^*(\omega,r) < \underline{a}) =& \Pr(a^*(\omega,r) < \underline{a}, w < \overline{a} + \alpha r) + \Pr(a^*(\omega,r) < \underline{a}, w > \overline{a} + \alpha r) \\
=& \Pr(\omega < \underline{a}(1+\delta r) - r(\delta\overline{a} - \alpha), w < \overline{a} + \alpha r) + \Pr(\omega < \underline{a} + \alpha r, w > \overline{a} + \alpha r) \\
=& \Pr(\omega < \underline{a}(1+\delta r) - r(\delta\overline{a} - \alpha)) \\
=& F\left(\underline{a} + r(\delta\underline{a} - \delta\overline{a} + \alpha)\right),
\end{aligned}$$

which is increasing for all r if and only if $\overline{a} > \underline{a} + \alpha/\delta$. Let

$$\tilde{a}(\delta,\alpha) \equiv \max\{\max_r \hat{a}(r), \underline{a} + \alpha/\delta\}. \tag{2}$$

It then follows that $\mathbb{E}_\omega(a^*(\omega,r))$ is increasing and $\Pr(a^*(\omega,r)$ is decreasing for all $r \geq 0$ if $\overline{a}(\delta,\alpha) > \tilde{a}$.

Finally, consider the probability that a soldier takes personal initiative above what the commander orders ($a^*(\omega,r) > \overline{a}$). Since $a^*(\omega,r) \leq \overline{a}$ for $\omega \leq \overline{a} + \alpha r$, we have

$$\begin{aligned}
\Pr(a^*(\omega,r) > \overline{a}) &= \Pr(a^*(\omega,r) > \overline{a}, w < \overline{a} + \alpha r) + \Pr(a^*(\omega,r) > \overline{a}, w > \overline{a} + \alpha r) \\
&= \Pr(a^*(\omega,r) > \overline{a}, w > \overline{a} + \alpha r) \\
&= \Pr(\omega - \alpha r > \overline{a}, w > \overline{a} + \alpha r) \\
&= \Pr(w > \overline{a} + \alpha r) = 1 - F(\overline{a} + \alpha r),
\end{aligned}$$

which is decreasing in r for $\alpha > 0$.

A2. RECORD CLASSIFICATION

The Russian Ministry of Defense's *Pamyat' Naroda* database contains multiple records per soldier, but does not provide a unique ID (e.g. military card number) to automatically match all records to the appropriate individual. In the absence of this unique ID, each record r_i ($i = 1, ..., 106$ mln) must be assigned to a cluster in the set $\{c_1, ..., c_N\}$, where c_j is a soldier (cluster of records) and N stands for (unknown) number of soldiers for whom we have records. In our baseline analyses, we solve this unsupervised classification problem using a probabilistic record linkage approach. To evaluate the performance of this procedure, we later also apply an alternative, deterministic fuzzy matching approach.

A2.1. Probabilistic approach

Our baseline approach builds on the probabilistic record linkage method proposed by Fellegi and Sunter (1969) and further developed by Enamorado, Fifield and Imai (2019) and implemented in their *R* package `fastLink`. While we use the main engine of in the `fastLink` package, our record classification problem is a bit idiosyncratic and requires some extra steps, as we detail below.

A2.1.1 Blocking Since comparing each pair of 106 million records is computationally infeasible, we first partition the data into blocks of records that are maximally similar on some fields (e.g. surname, first name, patronymic). We then assign records to clusters only within each block, per standard procedure in record linkage with large datasets.

The `fastLink` package has a functionality to create blocks using k-means classification of alphabetically ordered text fields. However, we found that for our application, the package's blocking scheme returns highly imbalanced blocks with many containing only a single record and some having millions of records. To obtain more balanced blocks, we used the following hierarchical procedure:

1. Partition records by the first letter of the surname, creating a set of *initial blocks*.
2. Within each initial block, identify *frequent surnames*, which appear at least 500 times.
3. Calculate the alphabetic order distance between each pair of surnames within each block. Using a size-constrained k-means clustering algorithm (Higgins, Sävje and Sekhon, 2016), cluster surnames within each initial block using frequent surnames as primary data points, forcing each cluster to have at least 500 unique surnames.
4. Partition blocks with more than 25,000 records further, using size-constrained k-means clustering based on the first name.
5. Partition remaining blocks with more than 25,000 records again using the patronymic.

The blocking procedure is *hierarchical* because it partitions the records based on the first name only if the partition on the last name alone was too coarse, and so on. We found that the hierarchical approach combined with the use of frequent surnames as primary data points for k-means clustering was particularly effective in achieving more balanced blocks, because it avoided creating clusters around misspelled names or clusters around rare surname-first name combinations, both of which generate imbalanced clusters. The procedure yielded 12,997 blocks ranging from 1,014 records to 29,748 records per block.

A2.1.2 Computing linkage probabilities The next step is to compute the probabilities that any two records belong to the same soldier within each of the 12,997 blocks. In the dataset, there are nineteen fields that can potentially inform these linkage probabilities. However, we found that applying the `fastLink` procedure for all nineteen fields was computationally infeasible. Therefore, we adopted a stratified approach by splitting the nineteen fields into three strata and then calculating linkage probabilities for each stratum. The fields were stratified as follows:

1. (1) surnames, (2) first name, (3) patronymic, (4) date of birth;
2. (5) birth region, (6) birth region (*oblast*), (7) birth district (*rayon*), (8) birth town, (9) discharge year, (10), discharge month, (11) discharge day;
3. (12) enlistment year, (13) enlistment month, (14) enlistment day, (15) enlistment oblast, (16) enlistment committee, (17) outcome, (18) rank, (19) military unit.

Let π_{ij}^{s} denote the probability that records i and j are a match based on the fields in stratum s. To compute the degree of matching across all three strata, we need to aggregate the probabilities π_{ij}^{1}, π_{ij}^{2}, and π_{ij}^{3} for each $i \neq j$ within a block. We impose a constraint that for any two pairs of records to be a match, it is necessary (but not sufficient) that they approximately match on the fields in the first stratum. Even if two records match exactly on the fields in the second and third strata, they cannot represent the same person if they do not have similar names and dates of birth.

We calculate *pairwise linkage weights* between records i and j across the three strata as

$$m_{ij} = \pi_{ij}^{1}(1 + \pi_{ij}^{2} + \pi_{ij}^{3}).$$

Two records *can* (but don't have to) be a likely match even if the probabilities π_{ij}^{2} and π_{ij}^{3} are small (or zero). We found it important to allow for this possibility to reduce the false negative match rate, because the fields in the second and third strata have many missing values and the probabilistic linkage tends to assign vanishingly small match probabilities for fully or partially missing fields. On the other hand, records i and j cannot be a likely match if π_{ij}^{1} is small because the fields in the first stratum have few missing values.

A2.1.3 Classification Having calculated the degree of matching m_{ij} for all pairs of records, we then assigned records into clusters. This classification problem is identical to that of finding a community structure in a non-binary directed network (Leicht and Newman, 2008), where each edge represents a degree of relationship between the nodes.

We solved this problem using Ward's hierarchical agglomerative clustering, which assigns nodes to the same cluster by minimizing the within-cluster variance of network edges (Murtagh and Legendre, 2014).

Similar to the problem we faced when creating blocks, a naive application of the clustering procedure results in highly imbalanced (and implausible) clusters, with some soldiers having hundreds or even thousands of records. To avoid this problem, we adopted a hierarchical approach: we start by assigning records into clusters using a low similarity threshold; and then we further partition only those clusters that have more than ten records using a higher similarity threshold. Experimentation with different parameters has shown that the results are affected very little by the chosen values of thresholds as long as they are not unreasonable (e.g., we could stop splitting clusters with fewer than 100 records, but this would be mean we are assuming that one soldier could have as many as 99 separate records in the dataset, which makes no sense).

Finally, for each cluster we calculated the *total linkage weight*, which measures how well all pairs of records assigned to a cluster link with each other. This weight is the geometric mean of pairwise linkage weights of all records assigned to a cluster k:

$$W_k = \left(\prod_{i<j} m_{ij} \right)^{1/n_k} = \left(\prod_{i<j} \pi^1_{ij}(1 + \pi^2_{ij} + \pi^3_{ij}) \right)^{1/n_k},$$

where n_k is the number of records assigned to cluster k. The theoretical range of the weight goes from from 0 (i.e. at least one pair of records within a cluster has zero degree of linkage) to 3 (i.e. all pairs in the cluster have pairwise linkage weights equal to one, $m_{ij} = 1$; matching probabilities are equal to one in all three strata of the matching fields). In our analyses with soldier-level data, we weight each observation by the total linkage weight W_k to give more weight to observations that are classified with greater certainty.[1]

A2.2. Record clustering via deterministic fuzzy matching

As a validation exercise, we also clustered the personnel records using deterministic fuzzy string matching. This procedure assigns records to clusters based on the string distances between a set of fields using preset thresholds. It entailed the following steps:

1. Select the same 19 record fields stratified into three groups, as outlined above.

2. Let d^f_{ij} denote string distance between records i and j on field f. After experiment-

[1]The entire probabilistic record classification procedure took about 60 hours on a high performance computing cluster with 32 cores.

ing with multiple distance measures, we settled on restricted Damerau-Levenshtein distance as it seems to produce the most face validity. Calculate the string distances d_{ij}^f for all the fields in the first strata (surname, first name, patronymic, year of birth).

3. Using the complete hierarchical clustering method, assign records *on field* f to the same cluster if the restricted Damerau-Levenshtein distance between each pair of strings within the cluster does not exceed two units for names and one unit for the year of birth. That is, we allow two field entries to belong to the same cluster if they are dissimilar on at most two characters for names and one character for the year of birth. We use different cutoffs because most birth years are assigned to the same cluster if we allow two mistakes in four-digit numbers, most of which start with 19.

4. Aggregate set of records i and j into the same cluster if they match within the bounds of an error on all four fields in the first stratum.

5. If a cluster contains more than two records, split each such cluster using the same procedure as above but now employing fields from the second stratum; if large clusters remain, split them again using fields from the third stratum.

In the above scheme, the distance between a string and a missing value (or a distance between two missing values) is assumed to be zero. This assumption is required since missing values cannot be modeled explicitly in this scheme, in contrast to the probabilistic approach. This assumption essentially means that whenever we do not observe evidence of two strings being different, we assume they are the same. For instance, a soldier may have a discharge record that lists his birth location and an award record, which does not list a birth location. We would fail to match these two records if we did not treat missing values as stated, which clearly would be in error.

A2.3. Evaluation I: marginal properties

We first evaluate the probabilistic clustering scheme by comparing the marginal properties of the soldier-level dataset generated by this scheme against the marginal properties of the dataset generated by the deterministic scheme. The two schemes differ on a number of dimensions, such as the distance metric, probabilistic vs deterministic assignment, and treatment of the missing values. If the marginal properties of the two datasets are reasonably similar, then the clustering scheme is robust with respect to the specific choices.

Table A2.1 shows that the two clustering schemes yield reasonably similar results. The deterministic scheme yields more clusters (soldiers) than the probabilistic scheme. Closer inspection shows that this is mostly because the deterministic procedure fails to match

	Probabilistic	Deterministic
Soldiers	11,606,552	12,415,618
K/WIA	22.42%	21.84%
MIA	20.17%	19.46%
POW	5.65%	5.33%
DDT	0.16%	0.15%
PUN	0.78%	0.72%
Medal	17.47%	15.89%
Promotion	12.9%	11.29%

Table A2.1: PROBABILISTIC AND DETERMINISTIC CLUSTERING, MARGINAL PROPERTIES.

many records with missing values. More important than the total number of clusters are the distributions of the key outcomes that we analyze. We see that the percentages of outcomes across the two datasets are very similar across all measures. This is a suggestive but nonetheless important indication that the clustering schemes worked "correctly" and are not greatly dependent on specific parametric choices.

A2.4. Evaluation II: comparison with ground truth

While typically, record linkage and clustering problems are unsupervised in the sense that we don't have the ground truth against which to compare the output of the algorithm, in this particular case, we have some *partial* access to the ground truth. About 11% of records (about 11.8M) contain a field named "ID card," which we believe denotes the identification number of a soldier's military card. The value of this ID is quite limited because it is only included in the award records and in some portion of enlistment records. This means we can only use it to cluster records with and between these types or records, but not others. But we can use this identifier to evaluate how well the probabilistic clustering scheme predicts these "ground truth" clusters for which we have data.

Within each block where records were clustered, we calculate the similarity between the ground truth clustering and the clustering generated by the probabilistic clustering scheme using three standard metrics: (1) true positive rate (TP), the proportion of records that belong to the same cluster that are also assigned to the same cluster by the algorithm; (2) true negative rate (TN), the proportion of records that belong to different clusters being assigned to different clusters; and (3) F_1 score defined as $\frac{TP}{TP+1/2(FP+FN)}$.

Figure A2.1 shows the distributions of three measures. The true positive rate is high across all blocks, ranging from 0.85 to 1, with over 51% of blocks above 95%. The true negative rate is also high across all blocks, with an average of 94%. Finally, the F_1 score also indicates high predictive accuracy across most blocks.

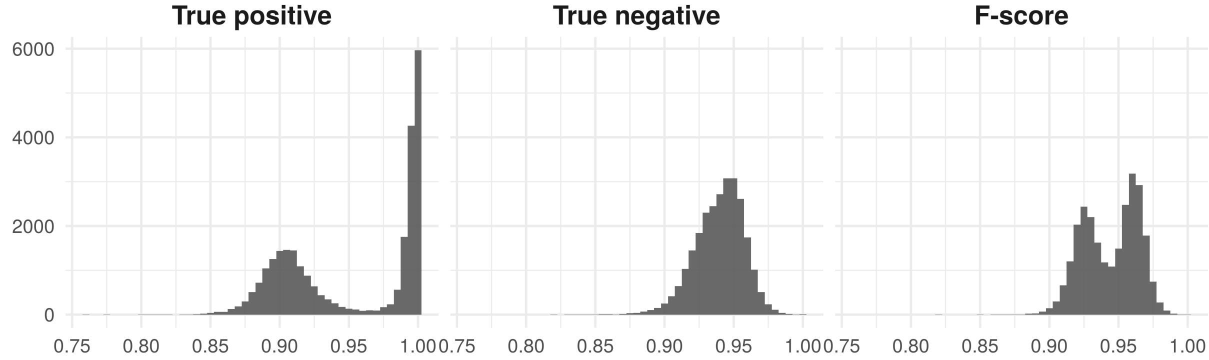


Figure A2.1: PERFORMANCE OF CLUSTERING SCHEME AGAINST THE GROUND TRUTH.

A3. VALOR DECORATIONS

A3.1. Categories of orders and medals

Soviet Army decorations and awards for WWII fell into multiple categories depending on their scope (individual, mass), target (civilian, military), merit (various classes of courage), timing (wartime, posthumous, commemorative), service and branch (aviation, infantry, armor, navy). Each category carried different parameters and standards for qualification. The USSR had a multi-tiered system of entities authorized to make award decisions, and this system itself was created based on award categories and their rank order.[2] The complex awarding system meant that any unique decoration might belong to one or multiple categories. As such, the qualification criteria and the decision-making authorities that oversaw the awarding process were unique to each award.

We focus on a particular set of decorations that were given specifically for individual initiative and valor. As a result, we exclude medals and orders awarded en masse to an entire unit (e.g. campaign medals)[3] or granted after 1945 as jubilee decorations.[4] We focus on decorations that were awarded only during WWII and for recognition of acts displayed on the battlefield. Filtering based on these criteria leads us to four military dec-

[2]In general, unit commanders were responsible for the recommendation of individual assignment and promotion of enlisted men at times of war. Upon recommendation by unit commanders, different government agencies were responsible for the conferral of the award. The Main Administration of Personnel of the Commissariat of Defense had discretion over ranks up to lieutenant colonel. The Council of People's Commissars was responsible for rank advancement decisions between the ranks of lieutenant colonel and marshal (Bolin, 1946).

[3]These decorations include medals awarded for the defense or capture of cities, such as "Medal for Defense of Leningrad", "Medal for Defense of the Caucasus", "Medal for Defense of Stalingrad", "Medal for the Capture of Berlin", "Medal for the Capture of Budapest", "Medal for the Victory over Japan", etc.

[4]There were significant changes to the awarding procedures and standards of all orders and medals in the postwar period that altered the definition of "merit" required for recognition.

oration categories: a) "For Courage," awarded to soldiers, borders and internal troops for personal courage and bravery displayed in defense of the Soviet Motherland and during the performance of military duties in circumstances involving a risk to life; b) "For Battle Merit," awarded for display of bravery during combat action resulting in a military success; c)"The Order of Glory," awarded to rank and file soldiers and non-commissioned officers of the Red Army for recognition of glorious feats of bravery, courage and fearlessness in combat for the Soviet Motherland; and d) "Hero of the Soviet Union" – the highest military distinction awarded for heroic feats in service to the Soviet Motherland.

A3.2. Medal "For Courage"

Established by a Decree of the Presidium of the Supreme Soviet on October 17, 1938, the Medal for Courage was intended for soldiers who provided active assistance to the success of military activities and for strengthening the combat readiness of troops. Soviet Army and Navy personnel, border and interior troops could receive the award. The description of the medal and the awarding regulations were amended by decrees of the Presidium of the Supreme Soviet of June 19, 1943 and on December 16, 1947.

"For Courage" was the second medal after "XX Years of the Red Army" to be established in the USSR. It was awarded mainly to rank and file soldiers and less often to junior officers. Senior officers and generals almost never received the Medal "For Courage". The first medals in this category were awarded two days after its establishment (62 soldiers). Approximately 26,000 servicemen received the medal before the start of the Great Patriotic War (we exclude these from our measure). Over 4,230,000 medals were awarded exclusively for feats performed during the war.

Awarding criteria

Criteria for recommending Medal "For Courage" included the following acts of bravery:

- For courage demonstrated in battles with the enemies of the Soviet Motherland;
- For courage demonstrated while protecting the state border of the Soviet Motherland;
- For courage demonstrated during performance of military duty in conditions associated with a risk to life.

A3.3. Medal "For Battle Merit"

The Medal "For Battle Merit" was established by a Decree of the Presidium of the Supreme Soviet on October 17, 1938 – on the same day as "For Courage". Subsequent changes to the description and awarding regulations took place on the same dates as "For Courage". Although, the Medal "For Battle Merit" was awarded to rank and file soldiers, civilians could also receive awards for wartime bravery. For instance, in summer 1941, a 15-year-old schoolboy Zhenya Nefedov received the Medal "For Battle Merit" in Moscow for his efforts against German incendiary bombs, with which Nazi bombers bombarded residential areas of Moscow. During one raid, the eighth-grader put out nine "lighters".

By the decree of June 4, 1944, the Presidium of the Supreme Soviet introduced a procedure for awarding orders and medals to servicemen of the Red Army for length of service. The only medal awarded to servicemen for 10 years of impeccable service was the Medal "For Battle Merit" (orders were awarded for 15, 20 and more years of service). This procedure of awarding "for length of service" was canceled only in 1958.

Our measure excludes the approximately 21,000 servicemen who received the medal before the start of the Great Patriotic War, and all those who received it after 1945.

Awarding criteria

Criteria for recommending the Medal for "For Battle Merit" included the following:

- For skillfull, proactive and courageous actions in battle that contributed to the successful fulfillment of combat missions by a military unit or subunit;
- For courage shown in defense of the state border of the Soviet Motherland;
- For excellent achievements in combat and training, mastering new military equipment and maintaining high combat readiness of military units and subunits during active military service.

A3.4. The Order of Glory

The Order of Glory was unique in that it could be awarded only for tactical-level combat valor and ranked among the most prestigious military decorations in Soviet history. It was reserved solely for enlisted personnel and non-commissioned officers (Empric, 2017).

Established by a decree of the Presidium of the Supreme Soviet on November 8, 1943, the Order of Glory comprised three distinct sequential classes, with the I class being the highest.[5] Soldiers received a right to be conferred a higher military rank and were referred

[5]Until 1974, the Order of Glory remained the only order of the USSR, issued only for personal merits and never issued to entire military units, enterprises or organizations. The only exception to this rule occurred once in January 1945, when the entire contingent of a single unit was awarded the Order of Glory. In battles for the liberation of Poland, during a break-through of deep-echeloned German defenses on the left bank of the Vistula river, the soldiers of the 1st battalion of the Red Banner 215th Regiment of

to as a "Full Cavalier of the Order of Glory" if awarded all three classes of the order.[6] Only 2,656 Red Army soldiers received all three classes of the Order of Glory during and after WWII, and over 9% of those approved between 1944 and 1946 were posthumous recognitions (Empric, 2017). By 1945, approximately 1,500 Orders of Glory of I class, 17,000 II class, and 200,000 III class had been awarded.

According to official wartime military personnel records, Full Cavaliers of the Order of Glory included representatives of 41 distinct Soviet ethnicities, with Russian comprising the largest ethnic group (70%), followed by Ukrainians (17%) and Belorussians (2%). Half of all Full Cavaliers fought in one of two Red Army fronts: the 1st Belorussian Front, commanded by Marshal of the Soviet Union Georgiy Zhukov, and the 1st Ukrainian Front, commanded by Marshal of the Soviet Union Ivan Konev. More than 50% of Full Cavaliers came from infantry, followed by artillery (26.5%), combat engineers (11.45%), tank and mechanized forces (3.46%), aviation forces (2.03%), and miscellaneous and support troops (4.3%) (Empric, 2017). Ten of the Full Cavaliers of the Soviet Union earned their decorations while serving their respective sentences in penal units.

Unit commanders at the brigade level or higher had the right to award the Order of Glory of III class. Army (flotilla) commanders could award the II class. Only the Presidium of the Supreme Soviet of the USSR could award the I class. In these cases, the battalion or brigade commander would initiate the award recommendation, which would then have to be approved by the division, corps, army and front commanders, before being dispatched to Moscow for final vetting and approval.

Awarding criteria

Criteria for recommending Orders of Glory included the following acts of bravery:

- As the first to burst into the enemy's position, by personal bravery, contributed to the success of the common cause;
- While in a burning tank, continued to carry out the combat mission;
- In a moment of danger, saved his unit's banner from enemy capture;
- With accurate fire from a personal weapon, destroyed from 10 to 50 enemy soldiers and officers;
- While in combat, using anti-tank rifle fire, knocked out at least two enemy tanks;
- Using hand grenades, destroyed from one to three tanks on the battlefield or in

the Orders of the Red Banner, Lenin and Suvorov 77th Guards Chernigov Infantry Rifle Division captured three lines of enemy trenches in a swift assault and held their positions until the main forces arrived.

[6]The statute of the order provided for the rank promotion of those awarded all three classes, which was an exception to the Soviet decoration system.

the enemy’s rear area;

- Using artillery or machine gun fire, destroyed at least three enemy aircrafts;
- Defying clear danger, as the first to burst into an enemy bunker (trench or dugout), destroyed its garrison with decisive actions;
- As a result of personal reconnaissance, determined weak points in the enemy’s defense and led forces into the enemy’s rear area;
- Personally captured an enemy officer;
- At night, removed the guard post (patrol) of the enemy or captured him;
- With resourcefulness and courage, personally made his way to the enemy’s position and destroyed his machine gun or mortar;
- While in night guard, destroyed the enemy’s warehouse with military equipment;
- While risking his life, saved the commander in combat from imminent danger that threatened him;
- Defying personal danger, captured the enemy banner in combat;
- While wounded, returned to duty following immediate treatment;
- Using personal weaponry, shut down an enemy aircraft;
- By destroying enemy firepower with artillery or mortar fire, ensured the successful operation of his unit;
- Under enemy fire, made a passage into the enemy’s wire fences for the advancing unit;
- Risking his life under enemy fire, assisted the wounded during a series of battles;
- Being in a destroyed tank, continued to carry out a combat mission from the tank’s weapons;
- Rapidly crashing into the enemy column on his tank, crumpled it and continued to carry out the combat mission;
- Crushed one or several enemy weapons with his tank or destroyed at least two machine-gun nests;
- While in reconnaissance mission, obtained valuable information about the enemy;
- In an air battle, as a fighter pilot, destroyed from 2 to 4 enemy fighter aircrafts or from 3 to 6 bomber aircrafts;
- As a result of an assault raid, as an attack pilot, destroyed 2 to 5 enemy tanks or 3 to 6 steam locomotives, or detonated a train at a railway station, or destroyed at least two aircrafts at an enemy airfield;
- As a result of bold initiative, as an attack pilot in an air battle, destroyed 1 or 2 enemy aircrafts;

- As members of the crew of daylight bombers, destroyed trains, blew up bridges, the ammunition depot and fuel, destroyed the headquarters of enemy unit, destroyed the railway station, blew up the power station or dam, destroyed a military ship, transport, boat, or destroyed at least two enemy aircrafts;
- As a crew member on a light night bomber, blew up an ammunition depot or fuel dump; destroyed the enemy's headquarters; blew up a railroad train or bridge;
- As a crew member on a long-range night bomber, demolished a railroad station; blew up an ammunition depot or fuel dump; demolished a port facility; destroyed a sea transport or a railroad train; demolished or burned down an important factory or mill;
- As a crew member on a daylight bomber, as a result of courageous actions in aerial combat, show down 1 to 2 enemy aircrafts;
- As a crew member on a reconnaissance aircraft, for successfully accomplished reconnaissance, which resulted in valuable intelligence about the enemy.

Examples
Below are several examples of individuals who received Orders of Glory of each class.

Order of Glory III Class
From the award page of machine-gunner Egorov Dmitriy Nikolaevich (b. 1923), awarded the Order of Glory III Class on January 30, 1945:

"On January 13, 1945, while repelling counterattacks by numerically superior enemy infantry in the center of Budapest, Comrade Yegorov destroyed the enemy's machine gun point and 12 enemy soldiers with his personal machine gun. On January 14, 1945, while advancing to a bridge over the Danube River, Yegorov killed 6 enemy soldiers and took 2 Hungarian soldiers as prisoners."

Commander of the 200th Guards Rifle Regiment
Guard Major Panin

From the award page of Squad Commander Marchenko Anatoliy Andreevich (b. 1917), awarded the Order of Glory III Class on February 20, 1945:

"On 14 February, 1945, in an offensive battle against the German invaders in the area of of the city of Wanzen of the 1st Ukrainian Front, while performing a combat mission to destroy a group of machine gunners with his squad, and while entrenched in a cemetery, he showed himself to

be a strong-willed, trained and staunch commander. He made his way through a break in the wall, chose a reliable shelter behind the stone, and with a long burst of machine gun destroyed the enemy's machine-gun crew of 3 people. The first to rise to the attack, he galvanized his squad and knocked out the entrenched machine gunners, in the meantime destroying 2 fascists with hand grenades. Clearing the houses of the city from the German machine gunners, he shot 3 Nazis and took the Hitler Banner of the military plant as war trophies. For the precise execution of a combat mission and decisive actions on the battlefield against the German invaders, comrade Marchenko is recognized with the Order of Glory III Class."

Commander of the 181st Infantry Regiment
Lieutenant Colonel Korkishko

From the award page of gunner Galyadinov Fayzirakhman Boltinovich (b. 1915), awarded the Order of Glory III Class on April 18, 1945:

"On April 18, 1945, during the hostilities in the Raygorod region, Comrade Galyadinov proved himself to be a courageous and staunch warrior. Comrade Galyautdinov's tank was destroyed on the battlefield. He ensured the exit of the entire tank crew covering them with his machine gun fire, and occupied a neighboring house with his crew to guard and defend the tank. During combat, Galyadinov destroyed a light machine gun and 2 soldiers of the enemy. Wounded in the chest, Comrade Galyadinov did not leave his place and remained in the cover of the tank until the infantry approached. His actions are recognized with the Order of Glory III Class."

Commander of the 78th Guards Heavy Tank Dnovsky Regiment
Guard Lieutenant Colonel Gerasimov

Order of Glory II Class

From the award page of cannon gunner, Guard Staff Sergeant Zolotikh Dmitriy Andreevich (b. 1924), awarded the Order of Glory II Class on August 27, 1944:

"On August 7, 1944, in a fierce battle during the liberation of Lesna station of Baranovichi region, using his 45-mm cannon in the infantry battle formations destroyed one German tank with a direct fire. The Germans, intensifying their onslaught and moving to a fierce counterattack with the support of 20 tanks, approached the firing position of his cannon at 100 meters. Wounded in the arm, he did not leave the battlefield and, not losing his composure in front of the enemy, opened a hurricane of fire on enemy tanks, and knocked out another tank, after which he destroyed up to 20 German soldiers and officers. After repeated orders from the fire platoon commander, he then left the battlefield. His actions are recognized with the Order of Glory II Class."

Commander of the 162th Guards Rifle Regiment
Guard Major Stepura

From the award page of foot reconnaissance platoon scout Shmonin Fyodor Vasilyevich (b. 1911), awarded the Order of Glory II Class on September 29, 1944:

"On August 21, 1944, in the battle for the village of Voinesti (Romania), Private Shmonin, showing fearlessness and courage, suddenly and carefully burst into a village and, having approached the house in which there were more than 30 German soldiers, he began to throw grenades at them and shoot the Germans running out of the house in a panic. In total, in this battle, Shmonin destroyed 12 German fascist invaders, and took 19 German soldiers as prisoners and brought them to the regiment headquarters. His actions are recognized with the Order of Glory II Class."

Commander of the 933th Rifle Regiment
Lieutenant Colonel Fimosin

From the award page of reconnaissance scout Dolgov Pyotr Nikolaevich (b. 1922), awarded the Order of Glory II Class on October 21, 1944:

"On October 2, 1944, during a night search for scouts in the area north-west of the city of Lomas, Comrade Dolgov was the first to cross the Narev River, and threw a cable rope to his comrades, thereby ensuring the crossing of the safe entire group. During the capture operation of the group, Comrade Dolgov silently crawled to the enemy trench and knocked down the German night guard. Having disarmed the enemy, Comrade Dolgov, with his comrades who arrived in time, delivered the prisoner to his destination. The mission was accomplished. His actions are recognized with the Order of Glory II Class."

Commander of the 444th Separate Reconnaissance Company
Senior lieutenant Pismorov

Order of Glory I Class

From the award page of SU-85 gunner, Sergeant Major Zaboev Vasiliy Andreevich (b. 1914), awarded the Order of Glory I Class on March 24, 1945:

"In battles near the village of Relsheersh, the vehicle commander was wounded during repeated attacks of the enemy. Comrade Zaboev assumed command and, in this battle, repelled 3 enemy attacks, destroyed 3 tanks, 2 guns, 2 mortarts, 1 machine-gun point, and up to 30 enemy soldiers

and officers. In the same battle Comrade Zaboev was seriously wounded, but did not leave his combat post, and brought his car out in good working condition. His actions are recognized with the Order of Glory I Class."

Commander 1438th Self-propelled Artillery Red Banner Order of Suvorov Regiment
Colonel Zatylkin

From the award page of Soldier Semyonov Yegor Dmitrievich (b. 1906), awarded the Order of Glory I Class on May 31, 1945:

"On March 27, 1945, during the assault on height 60.6 for liquidation of the Alt-kyustrinskoensky bridgehead on the right bank of the Oder River, Comrade Semyonov showed examples of stamina and fearlessness in battle. At the signal for the start of the attack, Comrade Semyonov was the first to break into the enemy's location and knocked down five Nazis in hand-to-hand combat. When pursuing the retreating enemy, the first light machine gun went out of order. Comrade Semyonov quickly replaced it and, with his fire, destroyed the enemy light machine gun and 12 German soldiers, scattering the retreating Germans. Thus, he ensured the rapid advancement of the rifle company. His actions are recognized with the Order of Glory I Class."

Commander 487th Red Banner Infantry Regiment
Lieutenant Colonel Tarasov

A3.5. Hero of the Soviet Union

The Hero of the Soviet Union was the highest degree of distinction of the Soviet period and the most prestigious title in the Soviet hierarchy of awards.

Established by a Decree of the Presidium of the Supreme Soviet on April 16, 1934, title of Hero of the Soviet Union was given for personal or collective services to the Soviet state and society associated with the performance of a heroic deed. Along with this title, the awardee received a) the highest award of the USSR — the Order of Lenin; b) a badge of special distinction — the Gold Star medal; and c) diploma of the Presidium of the USSR Supreme Soviet. The title also carried additional welfare privileges, such as medical, housing, entertainment benefits and a pension. The title of Hero of the Soviet Union was first conferred on April 20, 1934 to a number of Soviet aviators for rescuing the polar expedition and the crew of the Chelyuskin icebreaker.

On December 31, 1936, the title of Hero of the Soviet Union was for the first time awarded for military exploits. Eleven commanders of the Red Army — participants of the Spanish Civil War — became heroes. It is noteworthy that all of them were also pilots, and three of them were foreigners by origin: the Italian Primo Gibelli, the German Ernst Schacht and the Bulgarian Zakhari Zakhariev. Among the heroes was the lieutenant of the 61st fighter squadron, Chernykh S.A. In Spain, he was the first Soviet pilot to shoot down the latest Messerschmitt Bf 109B fighter. On June 22, 1941, he commanded the 9th Mixed Air Division. On the first day of the war, the division suffered huge losses (347 out of 409 aircraft of the division were destroyed). As a result, Chernykh was accused of criminal inaction and was executed on June 27, 1941.

In total, before the start of the Great Patriotic War, the title of Hero was awarded to 626 people (including 3 women), five of whom were twice heroes. 11,635 people (92% of the total number of heroes) were awarded the title during the Great Patriotic War. 101 were awarded twice and 3 were awarded thrice. In the first year of the war, only a few dozen people were awarded the title, all in the period from July to October 1941. By 1944, the number of Heroes of the Soviet Union increased by more than 3,000, mainly infantrymen. For the liberation of the Czechoslovakia, the title was awarded 88 times, for the liberation of Poland — 1667 times, for the Berlin operation — more than 600 times.

Among all the Heroes of the Soviet Union, 35% were enlisted, 61% were junior and field-grade officers and 3.3% (380 people) were generals, admirals and marshals. The youngest person to receive the title was 17-year-old partisan Lenya Golikov (posthumously). There were only two wartime cases when the title of Hero of the Soviet Union was awarded to all personnel in a unit, comprising 95 mostly posthumous decorations.

According to the ethnic composition, the majority of the Heroes were Russians — 7998 people, followed by 2,021 Ukrainians, 299 Belarusians, 161 Tatars, 107 Jews, 96 Kazakhs, 90 Georgians, 89 Armenians, 67 Uzbeks, 63 Mordvin, 45 Chuvashes, 43 Azerbaijanis, 38 Bashkirs, 31 Ossetians, 18 Mari, 16 Turkmen, 15 Lithuanians, 15 Tajiks, 12 Latvians, 12 Kyrgyz, 10 Komi, 10 Udmurts, 9 Estonians, 8 Karelians, 8 Kalmyks, 6 Kabardins, 6 Adygeis, 4 Abkhazians, 2 Yakuts, 2 Moldovans, and 1 Tuvinian.

Awarding criteria

The title could only be awarded by the Presidium of the Supreme Soviet of the USSR for exceptional heroic deeds. A Hero of the Soviet Union who performed a second heroic deed, no less than the one for which others who had performed a similar feat received the title of Hero of the Soviet Union, was awarded the Order of Lenin, a second Gold Star, and a commemorative bronze bust in his hometown. A Hero of the Soviet Union awarded two Gold Star medals could again receive the Order of Lenin and Gold Star for new heroic deeds similar to those previously committed.

Examples

From the award page of machine-gunner Bondarenko Pyotr Nikolaevich (b. 1921), awarded the title of the Hero of the Soviet Union on October 26, 1943:

"Guards gunner junior sergeant Bondarenko was among the first to cross with his weapon to the right bank of the Dnieper. On September 27, 1943, while fighting to repel enemy counterattacks, Bondarenko destroyed 4 firing points and up to 45 enemy soldiers with an open direct fire. In the battle on October 7, 1943, under heavy artillery fire and the attack of enemy aircraft, he fired at the enemy's counterattacking infantry, which was supported by 20 tanks. He was wounded by a sharpnel of a bomb, but despite the pain and severe bleeding, he continued to attack, setting fire to one T-4 tank and destroying up to 15 enemy soldiers. He was again wounded by sharpnel of another bomb, but despite being wounded, he continued to remain in the ranks. When repelling another counterattack, he was killed on the battlefield."

Commander of the 115th Krasnograd Guards Fighter Anti-Tank Artillery Regiment
Guard Lieutenant Colonel Kozyarenko

From the award page of junior lieutenant Marchenko Fyodr Illarionovich (b. 1919), awarded the title of the Hero of the Soviet Union on April 17, 1945:

"On April 14, 1945, in battles with the German invaders during the breakthrough of the heavily fortified enemy defenses on the West Bank of the Oder River, and during offensive operations, Comrade Marchenko, by his personal actions, inspired military deeds. In the battles for the village of Hardenberg on April 16, 1945, he showed exceptional courage and bravery. The Germans launched a counterattack. Comrade Marchenko personally led the unit, repelling the enemy's counterattack, with the slogan "Communists Forward For the Motherland", raising soldiers' spirits, and rushed to storm the enemy trenches. He was the first to break into the enemy trenches, where he destroyed 5 German soldiers and one officer from his personal weapons, taking 4 German soldiers as prisoners. Following his example, the soldiers knocked the enemy out of his trenches with a swift blow and began to pursue. In the ensuing battle on April 17, 1945, Comrade Marchenko, showing courage and personal bravery, led the fighters forward. In the same battle, he was seriously wounded by a sharpnel as a result of the enemy shelling and died because of his wounds. For the courage and bravery shown, Comrade Marchenko deserves to be posthumously awarded the title of Hero of the Soviet Union."

Commander of the 180th Guards Rifle Regiment
Guard Major Kuzov

From the award page of senior sergeant Nemchikov Vladimir Ivanovich (b. 1925), awarded the title of the Hero of the Soviet Union on July 12, 1944:

"The regiment commander ordered to pick up 12 people from a group of brave soldiers to perform a particularly difficult and dangerous task. The first to voluntarily express a desire to perform any task was guard senior sergeant Nemchikov, stating that he was ready to complete any task for the sake of defeating the enemy and even sacrifice his life. Having received the order, this group, by swimming in special suits, was supposed to ferry 6 rafts with stuffed effigies to the enemy's shore in order to direct enemy fire on themselves, which was then detected and suppressed by our artillery. However, some rafts with effigies were destroyed by Finnish artillery while still on the shore and could not be lowered into the water. Comrade Nemchikov made an independent decision, threw himself into the water and swam to the enemy's shore, directing all the fire on himself. Having reached the opposite bank, Comrade Nemchikov began to fighting with the Finns with his machine gun and move towards the enemy's trenches. A group of 12 people provided the battalion with a crossing into the Svir River and the battalion completed its task successfully."

Commander of the 300th Guards Rifle Regiment
Guards Colonel Danilov

A4. MEASUREMENT OF BATTLEFIELD OUTCOMES

We measure battlefield outcomes using soldiers' reported discharge reasons, which are proxies rather than direct observations of theoretically relevant quantities. For example, we use K/WIA as a proxy for resolve, even if many soldiers' deaths had little to do their actual levels of resolve. Here we evaluate the direction and degree of bias introduced by this kind of measurement error. We use the example of K/WIA as a proxy measure for having battlefield resolve, but the argument equally applies to other outcomes.

Let $Y_i^* \in \{0,1\}$ denote whether or not soldier i displayed battlefield resolve, which we cannot observe directly, and let $Y_i \in \{0,1\}$ denote whether or not that soldier was K/WIA, which we do observe. We formalize the measurement process that links observed outcome Y_i with the latent quantity Y_i^* as

$$\Pr(Y_i = 1 | Y_i^* = s, \boldsymbol{X}_i) = \varepsilon_s(\boldsymbol{X}), \tag{3}$$

for $s \in \{0,1\}$. The vector $\boldsymbol{X}_i$ represents the covariates that potentially affect the probability of K/WIA independently of the soldier's resolve, and $\varepsilon_1(\boldsymbol{X})$ and $\varepsilon_0(\boldsymbol{X})$ are measurement errors for soldiers with and without resolve, respectively.

Let D denote the level of repression and let $p^*(D, \boldsymbol{X}_i) = \Pr(Y_i^* = 1|\boldsymbol{X}_i, D)$ and $p(D, \boldsymbol{X}_i) = \Pr(Y_i = 1|\boldsymbol{X}_i, D)$ denote the probability that a soldier, conditional on repression and other covariates, has battlefield resolve or that he is K/WIA, respectively. We can estimate only the latter, but are interested in the former. By the law of iterated expectations we get

$$p^*(D, \boldsymbol{X}_i) = \frac{p(D, \boldsymbol{X}_i) - \varepsilon_0(\boldsymbol{X}_i)}{\varepsilon_1(\boldsymbol{X}_i) - \varepsilon_0(\boldsymbol{X}_i)}, \tag{4}$$

and so the marginal change in the probability that the soldier has battlefield resolve when repression increases is equal to

$$\frac{\partial}{\partial D} p^*(D, \boldsymbol{X}_i) = \frac{\partial}{\partial D} p(D, \boldsymbol{X}_i) \frac{1}{\varepsilon_1(\boldsymbol{X}_i) - \varepsilon_0(\boldsymbol{X}_i)}. \tag{5}$$

The partial derivatives on both sides are *in the same direction* if and only if $\Pr(Y_i = 1|Y_i^* = 1, \boldsymbol{X}_i) > \Pr(Y_i = 1|Y_i^* = 0, \boldsymbol{X}_i)$. The second term in the above equation is always strictly larger than one, and so the marginal effect on p is always smaller in absolute value than the marginal effect on p^*. Thus, under the assumption that a soldier who is more willing to fight has a greater chance of being K/WIA, which seems highly plausible, the measurement error in the outcome results in attenuation bias.

A4.1. Measurement validation through unit-level operational performance

To further assess how well our measures map onto the theoretical concept of resolve, we assess whether these individual-level battlefield outcomes aggregate to the operational-level success or failure of army units. Specifically, we looked at how predictive these measures are of territorial gains by the Red Army.[7] To conduct this analysis, we matched soldiers' records to the 225 major battles listed in the "People's Memory" database (`pamyat-naroda.ru/ops/`), using information on the army units in which they served and their months of service in those units. Because these battles were large, army-level operations, this linkage procedure required first establishing the "parent" army for each division, regiment, battalion or company listed in the soldier's service history, and then filtering the records to include only those corresponding to the time of the battle. We then calculated the

[7] A potential alternative measure of military effectiveness is the loss-exchange ratio (LER) between Soviet and German forces (i.e. enemy losses divided by friendly losses). We do not consider the LER here because (1) the Russian MOD has not made these statistics available at the battle level, (2) there is little evidence that Soviet commanders cared about the LER or used it as a metric of success, and (3) such an analysis would be almost tautological, with Soviet casualty statistics appearing on both the left and right side of the equation. By contrast, there is ample evidence that Soviet authorities used territorial changes as measures of effectiveness, as illustrated by the fact that nearly all battle descriptions in "People's Memory" mention them, and by the fixation on this metric in Stalin's wartime orders (e.g. "Not one step back!").

proportion of soldiers in each unit-month with each type of outcome (K/WIA, MIA, etc.).

To measure operational-level territorial gains, we conducted a text analysis of battle descriptions in "People's Memory", each approximately one paragraph in length. Rather than providing our own subjective assessment of battlefield success, this approach allows us to adopt the Russian MOD's own official characterization of events, which is more likely to reflect Soviet commanders' information set at the time. We read each description and classified it as denoting a territorial gain, loss, or no change in the status quo.

Because a small subset of descriptions were open to multiple interpretations (e.g. with Soviet troops advancing on one sector of the front, but retreating elsewhere), we accounted for measurement uncertainty by fitting a supervised machine learning model, with the manually-coded labels as a training set. Specifically, we employed a recurrent neural network (RNN) model with long short-term memory (LSTM) (Hochreiter and Schmidhuber, 1997). LSTMs are well-suited for learning problems related to sequential data, such as sequences of words of differential length, where the vocabulary is potentially large, and where context and dependencies between inputs are potentially informative for classification.[8] We employed a standard "vanilla LSTM" architecture (Graves and Schmidhuber, 2005), using the `keras` library in Python 3 (Chollet, 2015).[9]

Because our training set includes all 225 battles, we used 10 random subsets of these labels to train the model, setting aside the remainders for cross validation. This created 10 alternative sets of LSTM-classified battles, of which we retained the set with the highest out-of-sample predictive accuracy, as measured by the area under the Receiver Operator Characteristic (ROC) curve. In most instances, the network achieved convergence at < 100 epochs, with median predictive accuracy (area under ROC curve) of 0.94.

Figure A4.2 shows word clouds for event descriptions corresponding to territorial gains. The font size is proportional to word frequencies in the LSTM-predicted test set, for events predicted as being most likely to belong to this category (99th percentile). The word frequencies generally align with our qualitative understanding of territorial gains,

[8]For an introduction to LSTMs, with applications to political science, see Chang and Masterson (2020).

[9]At the center of this architecture is a memory cell and non-linear gating units, which regulate information flow into and out of the cell. A "vanilla LSTM" block features three gates (input, forget, and output), block input, a single cell, and an output activation function. The block's output recurrently connects back to the block input and all gates. Greff et al. (2017) demonstrated that this architecture performs well on a variety of classification tasks, and that common modifications do not significantly improve performance. To preprocess the text, we mapped each of the 225 desciptions into a real vector domain, with each word represented as an embedding vector of length 100. The purpose of this step is to encode words as real-valued vectors in a high dimensional space, where words more similar in meaning appear closer in the vector space. We limited the total number of words used in modeling to the 5000 most frequent ones. We used an LSTM layer with 100 memory units, and a dense output layer with a sigmoid activation function for binary predictions. We fit the model using the efficient ADAM optimization algorithm, with binary cross-entropy as the loss function.

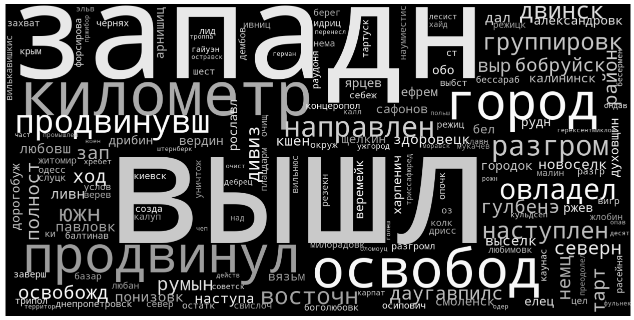


Figure A4.2: WORD CLOUD OF EVENT DESCRIPTIONS FOR TERRITORIAL GAINS.

with terms such as "advance" (the stems ,), "liberate" () and "to the west" () featuring prominently.

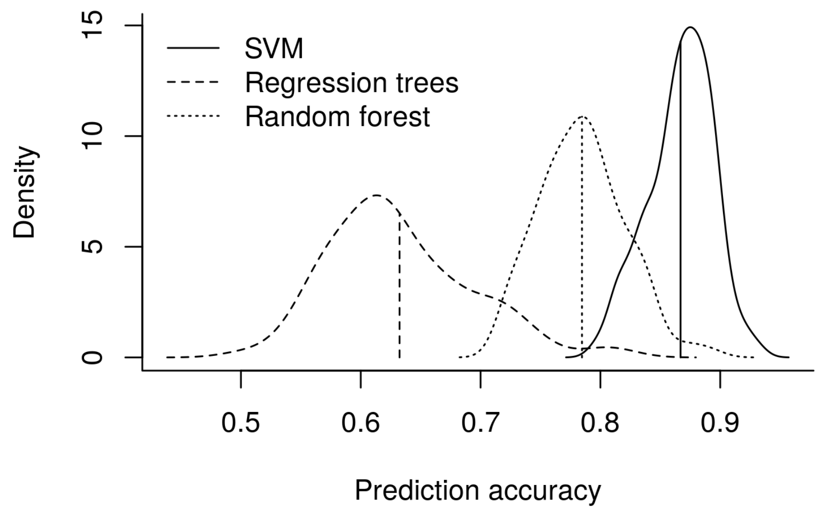
After linking the 225 battles to our unit-month level data, we regressed territorial gains on the proportion of participating soldiers K/WIA, DDT, PUN, POW, MIA, and Medals, along with fixed effects for units, years, and months. The results in Table 1 (main text) correspond to the hand-coded version of these battle outcomes. However, estimates are numerically almost identical if we use the LSTM-predicted labels.

A5. NATIONALITY CLASSIFICATION

To develop a Soviet nationality classifier, we used the Memorial archive as a training set. The archive contains nationality information for 916,675 arrestees, with 163,284 unique surnames. The set of nationalities includes: Armenian, Belarussian, Chechen, Chinese, Estonian, Greek, Jewish, Kabardin, Kalmyk, Korean, Latvian, Lithuanian, Ossetian, Polish, Russian, Tatar and Ukrainian. Because the same surnames reappear multiple times in the archive, often with more than one nationality (due to intermarriage or other reasons), dictionary-based matching of each surname to its corresponding nationality is not feasible. To account for the uncertainty induced by this one-to-many match problem, we used three supervised machine learning algorithms to create a classifier that matches each surname to its most-likely nationality. These classifiers are: Support Vector Machine (SVM), Regression Trees and Random Forest.

Due to the computational burden of fitting these models on a document-term matrix with 163,284 columns, we split the task into chunks of 1,000, and iterated over them. In each iteration, we created an $N \times 1000$ document-term matrix, where N is the number of individuals in Memorial who had one of the 1000 surnames in that chunk. We then fit a model, where the outcome is a $N \times 1$ vector of nationalities for each individual, and the explanatory variables are the 1000 unique surnames. We then calculated average classification accuracy for each algorithm (% of surnames correctly predicted). Because the set of surnames is fixed at 163,284, and extrapolation is not possible, we report only in-sample prediction accuracy below. Figure A5.3 reports the distribution of these accuracy scores for the three algorithms, with vertical lines showing the mean. SVM clearly outperforms the others, with regression trees faring the worst.

Figure A5.3: DISTRIBUTIONS OF CLASSIFIER ACCURACY SCORES.



Breaking these statistics down by nationality, we see that some groups (e.g. Russian) have fairly high accuracy scores (96.5% with SVM, 99.3% with Regression Trees, 94.7% with Random Forests). Others, like Ukrainians and Belarussians, don't score quite as high, even with SVM – likely due to intermarriage and similarity of surnames among the three biggest Slavic republics. In most erroneous cases, Belarusians and Ukrainians are typically mis-classified as Russians. For this reason, our analyses employ only a binary "ethnic Russian" variable, rather than using the full set of predicted ethnicities.

To assess the validity of our SVM classifications of soldiers' nationalities, we compared oblast-level proportions against census data from 1939. To do so, we spatially matched the census data to 1937 oblasts, and calculated oblast-level proportions for each nationality listed above. We then calculated oblast-level proportions of soldiers' SVM-classified nationalities, and compared these proportions to those in the 1939 census.

Table A5.2 reports the distribution of test statistics and p-values from Wilcoxon signed-rank tests, conducted country-wide, and by each oblast. The null hypothesis is that the distributions of oblast-level proportions across nationalities (e.g. Russian = .70, Ukrainian = .05, etc.) are the same for census and SVM data. These results suggest that – for all regions except the ethnically-diverse Chuvashiya and Dagestan – we cannot reject the null, and therefore the oblast-level proportions were likely drawn from the same distribution.

Table A5.2: WILCOXON SIGNED-RANK TEST STATISTICS FOR NATIONALITY CLASSIFIER.

Oblast′ (1937)	Wilcoxon Test	Oblast′ (1937)	Wilcoxon Test
RSFSR	181	Kurskaya Oblast′	125
Bashkirskaya ASSR	121	Kuybyshevskaya Oblast′	125
Checheno-Ingushskaya ASSR	132	Leningradskaya Oblast′	176
Chelyabinskaya Oblast′	140	Mariyskaya ASSR	106
Chuvashskaya ASSR	99*	Mordovskaya ASSR	108
Dagestanskaya ASSR	99*	Moskovskaya Oblast′	214
Dal′ne-Vostochnyy Kray	160	Omskaya Oblast′	150
Gor′kovskaya Oblast′	124	Saratovskaya Oblast′	156
Ivanovskaya Oblast′	122	Severo-Osetinskaya ASSR	143
Kabardino-Balkarskaya ASSR	135.5	Stalingradskaya Oblast′	146
Kalininskaya Oblast′	146	Sverdlovskaya Oblast′	147
Kalmytskaya ASSR	131	Tatarskaya ASSR	101
Karel′skaya ASSR	168	Udmurtskaya ASSR	120
Kirovskaya Oblast′	156	Voronezhskaya Oblast′	125
Komi ASSR	161	Yakutskaya ASSR	155
Krasnoyarskiy Kray	160	Yaroslavskaya Oblast′	151

Null hypothesis is that the distributions of oblast-level proportions across nationalities are the same for census and SVM data. Significance levels (two-tailed): $^{\dagger}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$.

A6. PROBING IDENTIFYING ASSUMPTIONS

A6.1. Tests of Complete Spatial Randomness

A key identifying assumption for our OLS analyses is that the local geographic distribution of arrest locations is spatially random. This assumption does not preclude the existence of geographic clusters on a more macro scale, or require a uniform distribution of events across the country – more arrests will surely happen in densely populated areas than in the desert or the tundra. What it assumes is that, after accounting for differences between small geographic areas (e.g. by estimating a fixed effect for each 25×25 km cell), we can treat remaining geographic variation within each of these areas as random. To test the validity of this assumption, we performed a series of tests of the null hypothesis that arrest locations are a realization of a uniform Poisson point process, including Quadrat Count Tests, Clark-Evans Tests, and Spatial Scan Tests.

The set of arrest locations within each grid cell represents a spatial point pattern, whose observed arrangement may be random (H_0) or the result of some non-random targeting process (H_A) (e.g. targeting of neighborhoods whom authorities suspect of disloyalty). Complete Spatial Randomness (CSR) requires that (a) events have an equal probability of occurring in any equally-sided subdivision of a region (i.e. if a grid cell is split into 4 tiles, an event has a $1/4$ chance of occurring in each tile), and (b) the locations of these events are independent of one another. If the CSR null hypothesis is true, and the point pattern is a realization of a random Poisson process, then the expected density of points (intensity of arrests) within grid cell j should be:

$$\lambda_j = \frac{n_j}{a_j} \quad (6)$$

where n_j is the total number of observed events within grid cell j and a_j is j's geographic area. If we divide j into K tiles of equal shape and area ($j_1, \ldots, j_K$), then the expected number of points in any given tile j_k should depend only on the overall point density within j and the relative area of the tile:

$$E[N(j_k)] = \lambda_j a_{j_k} = n_j \frac{a_{j_k}}{a_j} \quad (7)$$

The *Quadrat Count Test* (Cressie and Read, 1984) tests the CSR hypothesis by partitioning grid cell j into rectangular tiles of equal area, and compares the observed tile count distribution (i.e. number of tiles with 0, 1, 2, $\ldots$ events) against the distribution we would expect if these counts were independent random samples from a Poisson distribution with rate parameter λ_j. It then uses a Pearson's χ^2 goodness-of-fit test to quantify the difference between the observed and expected counts, with p-values calculated using Monte Carlo methods (i.e. generating 2000 random point patterns from $Poisson(\lambda_j)$ and comparing the χ^2 statistic for the observed point pattern against the simulated values).

We performed a series of Quadrat Count Tests for each of the 29,243 25×25 km grid cells in our study region, divided into $K \in \{1, 2^2 = 4, 3^2 = 9, 4^2 = 16, 5^2 = 25\}$ tiles of size 25×25 km, 12.5×12.5 km, 8.33×8.33 km, 6.25×6.25 km, and 5×5 km, respectively.

As Table A6.3 reports, we were unable to reject the null hypothesis (χ^2 test statistic p-value was greater than 0.05) in 91 percent of tests, including 100 percent of tests at $K = 1$ and 88 percent at $K = 25$. These results suggest that – for the vast majority of the grid cells in our sample, across all partitions – there is no significant difference between observed and expected local event counts.

We supplemented these analyses with alternative approaches, which use distances between event locations (rather than fixed areal partitions) to calculate test statistics. These include the *Clark-Evans Test* (Clark and Evans, 1954), which uses a Normal approximation

Table A6.3: QUADRAT COUNT TEST STATISTICS BY NUMBER OF TILES PER CELL.

Tiles per cell	Average χ^2 stat.	Average p value	$E[p > .05]$
1	0.00	0.93	(100%)
4	5.77	0.56	(92%)
9	13.78	0.47	(90%)
16	24.44	0.58	(88%)
25	35.97	0.58	(87%)
Overall	15.99	0.62	(91%)

Values represent average Pearson χ^2 test statistics and two-sided p values for Monte Carlo Quadrat Count Tests, calculated with each 25×25 km grid cell divided into different numbers of tiles: 1 tile (25 km across), 4 tiles (12.5 km), 9 (8.33 km), 16 (6.25 km) and 25 (5 km).

of the nearest-neighbor distance distribution D within region j, with mean and variance

$$E[D_j] = \mu_j = \frac{1}{2\sqrt{\lambda_j}}, \quad var(D_j) = \sigma_j^2 = \frac{4 - \pi}{4\pi\lambda_j} \tag{8}$$

where λ_j is the point density within grid cell j. To compare the observed distribution of distances to what we would expect under CSR, the test calculates a z-value:

$$z_j = \frac{\bar{d}_j - \mu_j}{\sigma_j} \tag{9}$$

where $\bar{d}_j$ is the sample mean of nearest-neighbor distances within grid cell j. Under the CSR null hypothesis, z_j should be a sample from $N(0, 1)$. p-values are based on a two-tailed test, where significantly small values of $\bar{d}_j$ indicate spatial clustering and significantly large values indicate spatial dispersion.

Finally, we performed *Spatial Scan Tests* for clustering in spatial point patterns (Kulldorff, 1997). This test rejects the null CSR hypothesis if there exists a circle of radius r within grid cell j, which contains significantly more points than one would expect under a uniform Poisson process. The alternative hypothesis is that of an inhomogeneous Poisson process with different intensities $\beta_1\lambda_j$ within the circle, and $\beta_2\lambda_j$ outside the circle.

As Table A6.4 reports, the results of these additional CSR tests were consistent with those of the Quadrat Test. We were unable to reject the null hypothesis in 87% of grid cells with the Clark-Evans test and 96% with the Spatial Scan test. In the vast majority of grid locations, the spatial distribution of arrests does not significantly deviate from what we would expect under Complete Spatial Randomness.

Table A6.4: TESTS OF COMPLETE SPATIAL RANDOMNESS.

Test	Average test stat.	Average p value	$E[p > .05]$
Quadrat	15.99	0.62	(91%)
Clark-Evans	0.53	0.53	(85%)
Spatial Scan	3.85	0.81	(95%)

Values represent test statistics and p values for Monte Carlo Quadrat Count Tests, two-tailed Clark-Evans Tests, and Spatial Scan Tests, averaged across all grid cells.

A6.2. FRDD exclusion restriction

The map in Figure A6.4 shows the borders included in the FRDD analyses. Each dot represents a birth location. A location colored in red is in the more repressive oblast, whereas a location colored in blue is in the less repressive oblast.

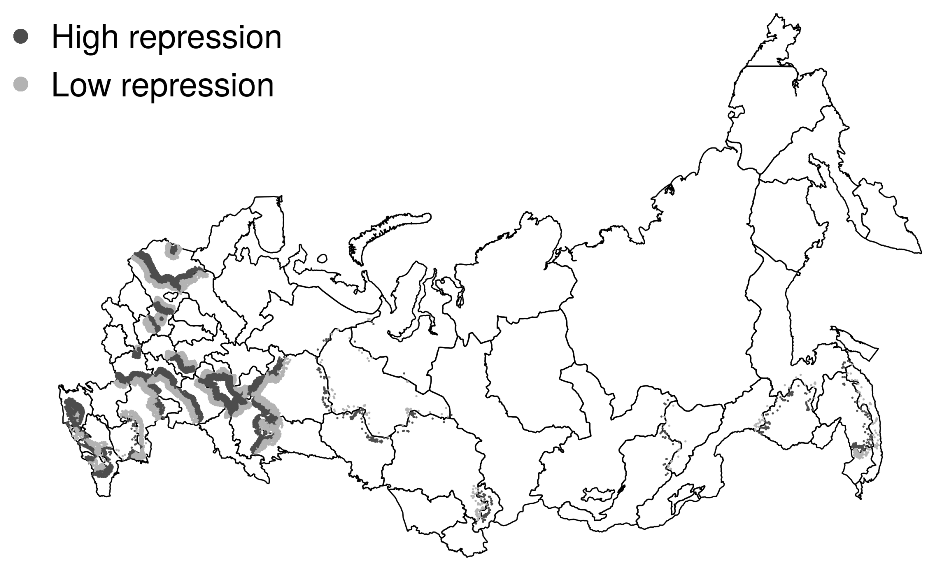


Figure A6.4: BORDER REGIONS INCLUDED IN FRDD ANALYSES.

A key identifying assumption behind FRDD is the exclusion restriction: differences in repression must be the only channel through which higher arrest rates across regional borders could influence battlefield outcomes. While a comprehensive test of all alternative causal pathways is not feasible, we consider two of the most likely violations here.

The first is a differential pace of mobilization. The same idiosyncratic factors that led to higher arrest rates across regional borders may also have led local administrators to be more efficient in drafting soldiers and transporting them to their battle stations in the early stages of the war, when death rates were particularly high. Although local military commissariats reported to a different government ministry — the People's Commissariat of Defense, not the People's Commissariat of Internal Affairs — it is quite possible that being under the watchful eye of zealous local secret police agents impacted their work.

Second, regions with higher repression may have had different reporting standards and record-keeping capacity, which affected the likelihood that soldiers' battlefield outcomes were fully observed in our data. This potential violation assumes a historically implausible level of inter-agency coordination — the NKVD had no role in drafting or cataloging soldiers' discharge records, which originated with military units in the field and were stored in defense ministerial archives. But it is not impossible for such information sharing to have taken place through informal bureaucratic channels.

To test these possibilities, we ran a series of reduced form FRDD regressions, with soldiers' draft dates, discharge dates, and missingness of outcomes on the left-hand side. The results, in Table A6.5, provide no evidence that soldiers from one part of border started or ended their service earlier than soldiers from the other side. However, the analyses do reveal a small negative correlation between missingness of outcomes and being born on the higher-repression side of the border. We consider how consequential this pattern of missingness is for our results in section A7.2 below.

	Start date	End date	Missing outcome
Model	Reduced form FRDD		
Border effect	-0.2 (0.5)	0.2 (0.4)	-0.04 (0.02)$^{\prime}$
Mean Y	302.3	14.6	0.5
Birthplaces	36,672	36,457	38,521
Gridcells	2,045	2,044	2,094
Soldiers	2,221,196	2,153,078	2,828,431

Standard errors in parentheses, clustered by birth location and grid cell. All models include individual and birth location-level covariates. Observations weighted by record clustering probability. Analyses exclude locations in non-matched regions and > 50km from regional borders. Significance levels (two-tailed): $^{\dagger}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$.

Table A6.5: BORDER EFFECTS AND VIOLATIONS OF EXCLUSION RESTRICTION

A7. Robustness checks

A7.1. Clustered treatment assignment

To address estimation problems due to clustered treatment assignment and unequal population size, we took three approaches: (1) pair-matched cluster sampling, (2) aggregate analysis of cluster-level averages, (3) both, and (4) aggregate district-level analysis. The first of these corrects for biases due to over-weighting larger clusters. The second addresses the problem of correlated errors within clusters. The third combines these two approaches for an even more conservative set of estimates. The fourth approach allows us to more directly account for local population size and urbanization.

Matched cluster sampling Our main individual-level analyses employ a the full sample of 11M+ soldiers, with cluster-level (birth location) exposure to repression. The clusters are geographic coordinates of soldiers' birth locations. The sample of 11M represents roughly a third of all soldiers who served in the Red Army during WWII, and exclused records with missing information on birth locations as well as those born in other Soviet republics outside the RSFSR. We assume that this missingness is random, and that we can treat the 11M individuals as a simple random sample. Under simple random sampling, however (e.g. take sample of 11M troops from across all clusters), individuals from larger clusters are more likely to appear in the sample than those from small clusters. This is a problem because (a) treatment is assigned at the cluster level, and (b) cluster size is potentially correlated with treatment (i.e. more arrests occurred in higher-population areas). One way to address this issue is to adopt a pair-matched cluster sampling design, which selects pairs of clusters that are as similar to each other as possible on observable pre-treatment covariates, including cluster size (Imai et al., 2009).

Our sampling strategy is a variant of one-stage cluster sampling, where the primary sampling unit is the cluster, and the secondary sampling unit is the soldier.[10] Let $j \in \{1, \ldots, J\}$ index the $J = 183,354$ clusters (birth locations). Rather than sampling these clusters with equal probability, as in a standard cluster random sample, we select a subset $J^{(m)}$, where $J^{(m)}/2$ of the clusters are "treated" (i.e. high level of repression) and another $J^{(m)}/2$ are "control" clusters (low repression) that are well-balanced on all ob-

[10]In a one-stage cluster sample, all soldiers within the sampled clusters remain in the sample, regardless of cluster size. We also replicated our results with a two-stage cluster sampling design, in which soldiers within sampled clusters are sampled with equal probability. The two-stage approach ensures that cluster samples are of equal size, at the expense of a reduction in statistical power. Results were similar to one-stage cluster sampling, but more weakly powered, suggesting that the selection of clusters is much more consequential than secondary sampling of soldiers within clusters.

servable pre-treatment cluster-level covariates $\boldsymbol{X}_j$.[11] The covariates in $\boldsymbol{X}_j$ include the same birth location-level covariates we use in out main analysis (distance to the nearest district administrative center, the number of collective farms and hectares of arable land within 10 km), along with cluster-level averages of local soldiers' ethnicity (proportion Russian) and age (average birth date).[12] We also matched exactly on grid cell and cluster size (quantile of number of draft records from location j). This last step ensures that within-cluster sample average treatment effects are uncorrelated with differences in cluster sizes within each matched-pair (Imai et al., 2009, p. 36).

Table A7.6: COVARIATE BALANCE STATISTICS, PRE- AND POST-MATCHING.

Covariate	Status	Mean Treated	Mean Control	Std. Diff.	KS Statistic
GRID ID	pre-matching	7913.627	7652.871	0.077	0.044**
	post-matching	8076.614	8076.614	0	0
Population quantile	pre-matching	2.469	2.421	0.041	0.02**
	post-matching	2.852	2.852	0	0
Ethnic Russian	pre-matching	0.869	0.864	0.021	0.014**
	post-matching	0.942	0.943	-0.007	0.012
Date of birth	pre-matching	1914.676	1914.752	-0.014	0.018**
	post-matching	1915.091	1915.098	-0.002	0.006
Cropland within 10km	pre-matching	1.486	1.32	0.139	0.077**
	post-matching	1.42	1.445	-0.021	0.012′
State farms within 10km	pre-matching	0.196	0.162	0.078	0.028**
	post-matching	0.192	0.19	0.004	0.004
Distance to district center	pre-matching	21.266	35.503	-0.6	0.165**
	post-matching	18.15	19.799	-0.101	0.146**
Distance to road junction	pre-matching	47.046	61.982	-0.426	0.07**
	post-matching	42.626	43.497	-0.03	0.043**

Tables A7.7 and A7.6 report the number of clusters pre- and post-matching (J vs. $J^{(m)}$) and corresponding covariate balance statistics. The matching procedure yielded a sample of 41,274 clusters, or 20,637 matched pairs. The procedure, by design, achieves perfect balance on grid cells and cluster size (population quantile). Balance on remaining covariates is also greatly improved, with all standardized differences falling below the conventional .25 threshold (Ho et al., 2007). Although these differences are numerically

[11]Matching requires transforming our non-negative integer treatment variable (number of arrests) into a dichotomous indicator, where clusters above some threshold of arrests are "treated" and those below it are "control". Because we are interested in local variation in repression, we allowed this threshold to vary by grid cell, such that locations above their grid cell median are "treated" and the rest are "control." Changing this thresholding rule from "grid cell median" to "grid cell mean," "regional median/mean" or "national median/mean" did not substantively change the results, apart from the matched sample size.

[12]We used Mahalanobis distance matching for these covariates.

Table A7.7: CLUSTER SAMPLE SIZE.

Status	Number of Clusters	Treated	Control
pre-matching	186,999	79,794	107,205
post-matching	41,272	20,636	20,636

Treated (Control) clusters are ones where the number of arrests is above (below) the grid cell median.

small, bootstrapped Kolmogorov-Smirnov statistics are indicate some remaining imbalance on ethnicity and distances to district centers and roads. We address this imbalance by controlling for these and all other pre-treatment covariates in our analysis.

The top row of Table A7.8 reports individual-level analyses for the matched cluster sample. These results align closely with those we report in the main text.

Cluster-level analysis We may worry that conventional standard errors are downwardly biased due to the presence of correlated errors within clusters. In our main analyses, we address this issue by reporting robust clustered standard errors (RCSE). Here, we go one step further, by conducting an aggregate, cluster-level analysis, which addresses the issue of correlated disturbances by eliminating within-cluster variation altogether (Green and Vavreck, 2008).

Our aggregate analyses adopt the same core specification as our main OLS model (equation 3 in main text), replacing y_{ij} with $\bar{y}_j$ (average of individual outcomes for cluster j), and $\boldsymbol{X}_{ij}$ with $\bar{\boldsymbol{X}}_j$ (cluster-level averages of pre-treatment covariates). Because cluster-level averages are more precisely estimated for clusters containing more individuals, we weighted each observation by cluster size.

The results of the cluster-level analyses are in the second row of Table A7.8. Estimates are substantively consistent with the individual-level results in the main text.

Matched cluster-level analysis The third row of Table A7.8 reports a more conservative set of estimates: an aggregate, cluster-level analysis that uses only the matched cluster pairs discussed above. Estimates align in direction and statistical with significance with those in our other analyses.

	KIA/WIA	Flee	MIA	POW	DDT	PUN	Medals
Units	Soldiers (matched clusters)						
Coefficient	0.5 (0.1)**	-0.2 (0.1)$'$	-0.2 (0.1)**	0.1 (0.1)	0.01 (0.003)*	-0.01 (0.01)	-0.4 (0.1)**
Mean Y	22	26.4	20.6	6.1	0.2	0.8	17.7
Birthplaces	41,272	41,272	41,272	41,272	41,272	41,272	41,272
Gridcells	3,815	3,815	3,815	3,815	3,815	3,815	3,815
Soldiers	4,489,873	4,489,873	4,489,873	4,489,873	4,489,873	4,489,873	4,489,873
Units	Soldiers' birthplaces						
Coefficient	0.6 (0.1)**	-0.2 (0.1)**	-0.2 (0.1)**	-0.05 (0.05)	0.01 (0.002)**	-0.01 (0.01)*	-0.2 (0.04)**
Mean Y	18	33.7	21	13.9	0.3	0.8	15.8
Gridcells	12,176	12,176	12,176	12,176	12,176	12,176	12,176
Birthplaces	180,895	180,895	180,895	180,895	180,895	180,895	180,895
Units	Soldiers' birthplaces (matched clusters)						
Coefficient	0.6 (0.1)**	-0.1 (0.1)	-0.3 (0.1)**	0.1 (0.1)	0.01 (0.003)$'$	-0.02 (0.01)$'$	-0.3 (0.1)**
Mean Y	17	30.8	21.8	9.9	0.2	0.8	17.8
Gridcells	3,815	3,815	3,815	3,815	3,815	3,815	3,815
Birthplaces	41,272	41,272	41,272	41,272	41,272	41,272	41,272
Units	Soldiers' districts						
Coefficient	1.3 (0.4)**	-0.6 (0.4)	-0.5 (0.2)*	-0.2 (0.4)	0.01 (0.01)*	0.02 (0.03)	-0.6 (0.2)*
Mean Y	19.3	25.9	20.4	5.8	0.2	0.8	18.3
Oblasts	39	39	39	39	39	39	39
Districts	336	336	336	336	336	336	336

Outcomes on percentage scale. Clustered standard errors in parentheses. All models include regional fixed effects, and group averages of individual and birth location-level covariates. Observations weighted by number of soldiers. Significance levels (two-tailed): $^{\dagger}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$.

Table A7.8: REANALYSIS WITH ALTERNATIVE SAMPLES AND UNITS OF ANALYSIS (FULL)

District-level aggregate analysis To more directly account for local population size and urbanization, we conducted aggregate analyses at the level of districts, which is the most fine-grained spatial unit for which 1926 Soviet census data are available ($N = 403$, including $N = 373$ within RSRFR's 1937 borders). These analyses adopt the same OLS specification as our main models (equation 3), replacing y_{ij} with $\bar{y}_j$ (average of individual outcomes for district j), and $\boldsymbol{X}_{ij}$ with $\bar{\boldsymbol{X}}_j$ (district-level averages of pre-treatment covariates). We further replaced grid-cell level fixed effects with regional (oblast) fixed effects, and added covariates for district population size (logged) and urbanization (percent residing in urban areas). Because district-level averages are more precisely estimated for areas with more individuals, we used population weights.

The results of the district-level analyses are in the bottom panel of Table A7.8. Estimates are substantively consistent with our individual-level and cluster-level results.

A7.2. Measurement error due to incomplete records

Another robustness check explores the possibility that measurement error due to incomplete records is driving our results. Table A7.9 replicates the earlier OLS and FRDD analyses on a restricted sample, which excludes individuals whose reseasons for discharge are not observed. As the results show, after we drop the more ambiguous cases of draftees without observed terminal histories, the estimated coefficients are in the same direction as in our baseline specifications and they increase in absolute value, sometimes considerably. Results for wartime decorations and promotions are identical to those in the main paper because information for these variables comes from a separate set of archival materials, and does not require observing discharge records. These results indicate that – in most cases – measurement error is likely to bias our estimates downwards.

A7.3. Alternative measure of initiative

The results in Table 2 use a composite measure of intitiative, which takes the value of 1 if a soldier received at least one of four valor decorations. A potential concern with this measure is that, because 17.5% of soldiers received at least one such medal, this variable is insufficiently selective to faithfully capture battlefield initiative. By way of a robustness test, we replicated our analyses with a more selective subset of decorations, focusing on the *Order of Glory*. This medal has the distinction of being highly prestigious — just 2.3% ($N = 270,473$) of soldiers in our sample received one — but not so uncommon as to preclude credible estimation.[13] The results, in Table A7.10, are consistent with those in the

[13] By contrast, 9.3% of the soldiers in our sample ($N = 1.1M$) received the medal *For Courage*, 8.2% received *For Battle Merit* ($N = 960,734$), and 0.05% received *Hero of the Soviet Union* ($N = 5,815$). 2.5%

main text: soldiers more exposed to repression were less likely to receive this decoration.

	KIA/WIA	Flee	MIA	POW	DDT	PUN	Medals
Model				OLS			
Coef. for Repression	0.7 (0.1)**	-0.8 (0.1)**	-0.6 (0.1)**	-0.2 (0.1)**	0.02 (0.005)**	-0.03 (0.01)*	-0.2 (0.1)**
Mean Y	47.4	56.8	44.5	12.8	0.4	1.7	17.9
Birthplaces	156,022	156,022	156,022	156,022	156,022	156,022	180,895
Gridcells	11,540	11,540	11,540	11,540	11,540	11,540	12,176
Soldiers	5,112,428	5,112,428	5,112,428	5,112,428	5,112,428	5,112,428	11,351,164
Model				FRDD (First-stage $\mathcal{F} = 14$)			
Coef. for Repression	3.1 (0.8)**	-3.1 (0.8)**	-3.2 (0.8)**	0.1 (0.4)	-0.01 (0.01)	-0.2 (0.1)*	-0.9 (0.3)**
Mean Y	46.4	57.7	44.4	13.7	0.4	1.8	17
Birthplaces	33,191	33,191	33,191	33,191	33,191	33,191	38,521
Gridcells	2,005	2,005	2,005	2,005	2,005	2,005	2,094
Soldiers	1,279,002	1,279,002	1,279,002	1,279,002	1,279,002	1,279,002	2,828,431

OLS and FRDD estimates. Outcomes on percentage scale (0 to 100). Robust standard errors in parentheses, clustered by birth location and grid cell. All models include grid cell fixed effects, individual and birth location-level covariates. Observations weighted by record linkage probability. FRDD analyses exclude locations in non-matched regions and > 50km from regional borders. Significance levels (two-tailed): $^{\dagger}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$.

Table A7.9: ESTIMATES FOR SOLDIERS WITH OBSERVED DISCHARGE RECORDS.

A7.4. Estimates adjusting for unit and month fixed effects

Table A7.11 reports the full set of estimates for regressions that include fixed effects for the unit to which soldiers were assigned, and the month of the corresponding deployment.

received more than one decoration.

	OLS	FRDD
Coef. for Repression	-0.1 (0.02)**	-0.3 (0.1)**
Mean Y	2.4	2.2
First Stage $\mathcal{F}$		13.6

Outcome = receiving an *Order of Glory* (*Orden Slavy*) decoration of first, second or third class, measured on percentage scale (0 to 100). See the note under Table 2 for the number of soldiers, birthplaces, grid cells, and other details. Significance levels (two-tailed): $^{\dagger}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$.

Table A7.10: REPRESSION AND ORDER OF GLORY DECORATIONS

	KIA/WIA	Flee	MIA	POW	DDT	PUN	Medal
Model	OLS						
Coef. for Repression	0.2 (0.04)**	-0.1 (0.03)**	-0.1 (0.03)*	-0.02 (0.01)*	0.01 (0.004)*	-0.03 (0.01)**	-0.02 (0.03)
Mean Y	40.3	19.2	16.1	1.9	0.2	1.2	8.3
Birthplaces	134,351	134,351	134,351	134,351	134,351	134,351	134,351
Gridcells	9,808	9,808	9,808	9,808	9,808	9,808	9,808
Soldiers	5,470,129	5,470,129	5,470,129	5,470,129	5,470,129	5,470,129	5,470,129
Model	FRDD (First-stage $\mathcal{F} = 18.1$)						
Coef. for Repression	1.2 (0.4)**	-0.7 (0.2)**	-0.2 (0.2)	-0.3 (0.1)**	-2e-04 (0.01)	-0.2 (0.1)**	-0.03 (0.1)
Mean Y	51.9	20.9	17	2.7	0.2	1.3	7.6
Birthplaces	1,590	1,590	1,590	1,590	1,590	1,590	1,590
Gridcells	19,450	19,450	19,450	19,450	19,450	19,450	19,450
Soldiers	756,455	756,455	756,455	756,455	756,455	756,455	756,455

Outcomes on percentage scale (0 to 100). Standard errors in parentheses, clustered by birth location and grid cell. All models include grid cell, unit and month fixed effects, individual and birth location-level covariates. Observations weighted by record linkage probability. Sample includes disaggregated personnel records, with non-missing unit and date information. FRDD analyses exclude locations in non-matched regions and > 50km from regional borders. Significance levels (two-tailed): $^{\dagger}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$.

Table A7.11: ESTIMATES ADJUSTING FOR MILITARY UNIT AND MONTH (full).

A7.5. Subset analyses

Tables A7.12 and A7.13 report estimated effects of repression on KIA/WIA and medals, respectively, in the subset of soldiers who did not flee the battlefield. Among soldiers who did not flee, 26% eventually died or were wounded, and 23% received one of the four valor decorations. Within this subgroup, repression continued to have a positive effect on one's probability of being KIA/WIA, and a negative effect on medals.

Tables A7.14 and A7.15 report additional estimated effects of repression on medals, now among subsets of soldiers who survived, and among soldiers who were KIA/WIA. Relatively few valor decorations were awarded posthumously, although this was not entirely uncommon: 6% of soldiers who were KIA/WIA received one of the four medals, compared to 21% among those who survived to the end of the war. In each case, estimated effects of repression continued to be negative, although these effects are more precisely estimated in the "no KIA/WIA" subset.

	OLS	FRDD
Coef. for Repression	0.5 (0.1)**	2.1 (0.7)**
Mean Y	25.9	25.6
First Stage $\mathcal{F}$		14.4
Birthplaces	153,893	32,244
Gridcells	10,419	1,936
Soldiers	8,446,981	2,089,967

Outcome = killed or wounded in action (KIA/WIA), conditional on not fleeing. Outcome measured on percentage scale (0 to 100). Standard errors in parentheses, clustered by birth location and grid cell. All models include grid cell fixed effects, individual and birth location-level covariates. Observations weighted by record clustering probability. FRDD analyses exclude locations in non-matched regions and > 50km from regional borders. Significance levels (two-tailed): $^{\dagger}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$.

Table A7.12: REPRESSION AND DEATH/INJURY (CONDITIONAL ON NOT FLEEING)

A7.6. Estimates with alternative bandwidths

Our main analyses measure exposure to repression as the logged number of arrests within a 10 km bandwidth of a soldier's birth location. To assess the sensitivity of our results to this choice, Table A7.16 reports OLS coefficient estimates at alternative bandwidths from 1 to 20 km. For all bandwidths smaller than 10 km, estimates were consistent in sign and close in magnitude and precision to those at the 10 km baseline. For larger bandwidths, estimates remain mostly consistent in sign, but begin to attenuate and lose precision after

	OLS	FRDD
Coef. for Repression	-0.3 (0.1)**	-1.3 (0.4)**
Mean Y	22.8	21.8
First Stage $\mathcal{F}$		14.4

Outcome = receiving at least one valor decoration (*For Battle Merit*, *For Courage*, *Order of Glory*, *Hero of Soviet Union*), conditional on not fleeing. See the note under Table A7.12 for the number of soldiers, birthplaces, and grid cells in each specification.

Table A7.13: REPRESSION AND INITIATIVE (CONDITIONAL ON NOT FLEEING)

	OLS	FRDD
Coef. for Repression	-0.2 (0.1)**	-0.6 (0.2)*
Mean Y	21	19.9
First Stage $\mathcal{F}$		12.7
Birthplaces	170,593	36,212
Gridcells	11,859	2,054
Soldiers	8,927,160	2,234,890

Outcome = receiving at least one valor decoration (*For Battle Merit*, *For Courage*, *Order of Glory*, *Hero of Soviet Union*), conditional on not being KIA/WIA.

Table A7.14: REPRESSION AND INITIATIVE (CONDITIONAL ON NOT KIA/WIA)

15 km. This attenuation pattern is not surprising, since larger bandwidths produce a smoother map with less local variation in the repression measure.[14]

A7.7. Local effect heterogeneity

As noted in the main text, the magnitude of our OLS coefficient estimates is consistently smaller than their FRDD counterparts. Potential explanations for these differences include measurement error (e.g. underestimation of arrests in places with generally higher K/WIA rates), and local effect heterogeneity (i.e. the impact of repression was stronger in areas closer to some regional borders). While it is difficult to quantify the influence of measurement error on estimation in this case, we are able to rule out at least one source of local effect heterogeneity. The locality of FRDD effect estimates is driven by a com-

[14]As bandwidths become so large that individuals born in the same grid cell have nearly-identical numbers of arrests, virtually all variation in repression becomes cross-grid cell (captured by fixed effects) rather than within grid cells (captured by the repression exposure measure). Larger bandwidths therefore necessitate changes to model specification, with fixed effects for grid cells of larger size.

	OLS	FRDD
Coef. for Repression	0.03 (0.04)	-0.4 (0.1)**
Mean Y	6.2	5.8
First Stage $\mathcal{F}$		17.8
Birthplaces	110,937	22,875
Gridcells	9,365	1,779
Soldiers	2,424,004	593,541

Outcome = receiving at least one valor decoration (*For Battle Merit*, *For Courage*, *Order of Glory*, *Hero of Soviet Union*), conditional on being KIA/WIA.

Table A7.15: REPRESSION AND INITIATIVE (CONDITIONAL ON KIA/WIA)

	KIA/WIA	Flee	MIA	POW	DDT	PUN	Medals
1km	0.7 (0.2)**	-0.03 (0.1)	-0.1 (0.1)	0.04 (0.04)	0.005 (0.002)**	0.01 (0.01)	-0.3 (0.1)**
5km	0.3 (0.1)**	-0.2 (0.1)**	-0.2 (0.05)**	-0.01 (0.04)	0.005 (0.001)**	-0.01 (0.01)*	-0.2 (0.1)**
10km	0.4 (0.1)**	-0.1 (0.1)*	-0.1 (0.1)*	-0.03 (0.04)	0.01 (0.002)**	-0.01 (0.005)	-0.2 (0.1)**
15km	0.3 (0.1)**	-0.1 (0.1)	-0.03 (0.1)	-0.1 (0.1)	0.004 (0.003)	-0.003 (0.01)	-0.1 (0.1)
20km	0.04 (0.1)	0.1 (0.1)	0.1 (0.1)	0.003 (0.1)	0.002 (0.003)	-5e-04 (0.01)	-0.01 (0.1)

See the notes under Table 2 for details. Significance levels (two-tailed): $^{\dagger}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$.

Table A7.16: COEFFICIENT FOR REPRESSION AT ALTERNATIVE BANDWIDTHS (1–20 KM).

bination of sample selection (we restricted FRDD analyses to locations within 50 km of regional borders) and differences in repression's effect on compliers versus the general population. In Table A7.17, we reestimate our OLS fixed effect models on the subsets of data used to fit our FRDD models. While these subset analyses do not directly address the compliance issue, they clearly show that sample selection cannot explain the differences in magnitude. Effect estimates are nearly identical in magnitude across these samples, and do not approach anything resembling the almost tenfold differences we see between some of the OLS and FRDD coefficients.

A7.8. Estimates adjusting for peer effects

Soldiers' choices to fight, flee, or show initiative may reflect not only their prewar experiences but also the backgrounds and actions of others in their unit. In this last analysis, to better understand the mechanisms behind our results, we examine the interdependence of the soldier-level outcomes within the units in which they served.

Following the econometric approach of Carrell, Sacerdote and West (2013), we esti-

	KIA/WIA	Flee	MIA	POW	DDT	PUN	Medals
Model	OLS sample						
Coef. for Repression	0.4 (0.1)**	-0.1 (0.1)*	-0.1 (0.1)*	-0.03 (0.04)	0.01 (0.002)**	-0.01 (0.005)	-0.1 (0.02)**
Mean Y	21.4	25.6	20.1	5.7	0.2	0.8	2.4
Birthplaces	180,895	180,895	180,895	180,895	180,895	180,895	180,895
Gridcells	12,176	12,176	12,176	12,176	12,176	12,176	12,176
Soldiers	11,351,164	11,351,164	11,351,164	11,351,164	11,351,164	11,351,164	11,351,164
Model	FRDD sample						
Coef. for Repression	0.5 (0.2)**	-0.1 (0.2)	-0.1 (0.1)	-0.003 (0.1)	0.02 (0.005)**	-0.002 (0.01)	-0.1 (0.04)**
Mean Y	21	26.1	20.1	6.2	0.2	0.8	2.2
Birthplaces	38,521	38,521	38,521	38,521	38,521	38,521	38,521
Gridcells	2,094	2,094	2,094	2,094	2,094	2,094	2,094
Soldiers	2,828,431	2,828,431	2,828,431	2,828,431	2,828,431	2,828,431	2,828,431

Outcomes on percentage scale (0 to 100): killed or wounded in action (KIA/WIA); missing in action (MIA), becoming prisoner of war (POW), defecting, deserting, committing treason (DDT), being punished for battlefield misconduct (PUN), or any of the above (Flee); receiving a personal valor decoration (Medal). Standard errors in parentheses, clustered by birth location and grid cell. All models include grid cell fixed effects, individual and birth location-level covariates. Observations weighted by record linkage probability. FRDD sample excludes locations in non-matched regions and > 50km from regional borders. Significance levels (two-tailed): $^{\dagger}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$.

Table A7.17: OLS Analyses on Restricted Samples.

mate the following equation:

$$y_{it} = \gamma \cdot \text{Repression}_{j[i]} + \rho \cdot \overline{y}_{ut[-i]} + \zeta \cdot \overline{\text{Repression}}_{ut[-i]} + \boldsymbol{\beta}' \boldsymbol{X}_{ij} + s\big(\text{lon}_{j[i]}, \text{lat}_{j[i]}\big) + \text{Cell}_{k[i]} + \text{Unit}_{ut[i]} + \text{Month}_{t[i]} + \epsilon_{it}, \quad (10)$$

where $\overline{y}_{ut[-i]}$ and $\overline{\text{Repression}}_{ut[-i]}$ are the average outcome and level of repression for soldier i's peers in unit u and month t (calculated excluding soldier i); ρ and ζ are the endogenous and exogenous peer effects, respectively (Manski, 1993). Our identifying assumption is that exogenous peer effects did not significantly impact combat motivation ($\zeta = 0$). Essentially, we assume that soldiers had limited ways of learning about their peers' level of exposure to repression. This seems plausible because repression was a taboo topic and long-term bonds between soldiers — through which such information might pass — could not crystallize due to high turnover. Provided that $\rho \neq 1$ and $\gamma \neq 0$, we can solve for the reduced form equation, which can be estimated using OLS:

$$\begin{aligned} y_{it} =& \gamma \cdot \text{Repression}_{j[i]} + \psi \cdot \overline{\text{Repression}}_{ut[-i]} + \boldsymbol{\beta}' \boldsymbol{X}_{ij} + s\big(\text{lon}_{j[i]}, \text{lat}_{j[i]}\big) \\ & + \text{Cell}_{k[i]} + \text{Unit}_{ut[i]} + \text{Month}_{t[i]} + \epsilon_{it} \end{aligned} \tag{11}$$

where $\psi = \gamma\rho/(1-\rho)$ is the reduced form peer effect.

The estimates are valid only if the assignment of soldiers to units with low versus high average levels of repression is exogenous. This assumption is plausible given the results in Table 4 and the pressures of general mobilization. Soviet mobilization plans left little room for accommodating the individual preferences of 30 million military-age males (i.e. no self-selection) or organizing unit composition on a dimension as obscure as exposure to repression. Unit assignment had some systematic components — reservists with prior training were sent to the front more quickly than untrained conscripts, military commissariats responsible for implementing the draft were organized by regional military district (most covering tens of thousands of square kilometers), and specialized units existed for soldiers with both exceptional skills (e.g. special forces) and disciplinary problems (e.g. penal units). However, these specialized units represented a tiny share of the army, and we can address the correlation of individual abilities through unit fixed effects. We can similarly account for geographic sorting with fixed effects for the grid cell of a soldier's birth. Monthly fixed effects further account for common shocks due to seasonal variation and the changing dynamics of the war. In cases where the unit assignment was based on conscripts' observable characteristics (e.g. age, ethnicity, class), controlling for these variables should eliminate the potential upward bias in estimated group coefficients.

Table A7.18 reports the estimated reduced form parameters, and the endogenous peer effects recovered from these estimates ($\hat{\rho} = \hat{\psi}/(\hat{\psi} + \hat{\gamma})$). The coefficient estimate on individual exposure to repression ($\hat{\gamma}$) is consistent with our baseline: after controlling for the repression of a soldier's peers from the same unit (and other covariates), a one-quartile increase in repression (0 to 32 arrests) raised one's chances of death or injury by 0.7 percentage points and reduced the probability of medals by 0.4 points. With the potential exception of the aggregate flight index — which loses significance — our baseline individual-level estimates are robust to the inclusion of peer effects.

For all three outcomes, the endogenous peer effect estimate ($\hat{\rho}$) is positive and significant at the 95 percent confidence level, confirming that soldiers' fortunes were positively correlated with those of others in their unit. If one's unit took exceptionally high losses in a given month, an individual's own chances of death or injury were considerably higher. A similar pattern was held for the probabilities of fleeing or receiving a medal. Soldiers'

	KIA/WIA	Flee	Medal
Direct individual effect ($\hat{\gamma}$)	0.2 (0.03)**	-0.01 (0.02)	-0.1 (0.02)**
Reduced form peer effect ($\hat{\psi}$)	0.5 (0.03)**	-0.1 (0.02)**	-0.2 (0.02)**
Endogenous effect ($\hat{\rho}$)	0.8 (0.03)**	0.9 (0.2)**	0.7 (0.1)**
Mean Y	27.6	12.9	8.5
Gridcells	9,639	9,639	9,639
Birthplaces	127,872	127,872	127,872
Soldiers	4,843,343	4,843,343	4,843,343

Outcomes on percentage scale (0 to 100). Bootstrapped standard errors in parentheses. All models include grid cell, unit and month fixed effects, individual and birth location-level covariates. Observations weighted by record linkage probability. Sample includes disaggregated personnel records, with non-missing unit assignment and date information. Significance levels (two-tailed): $^{\dagger}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$.

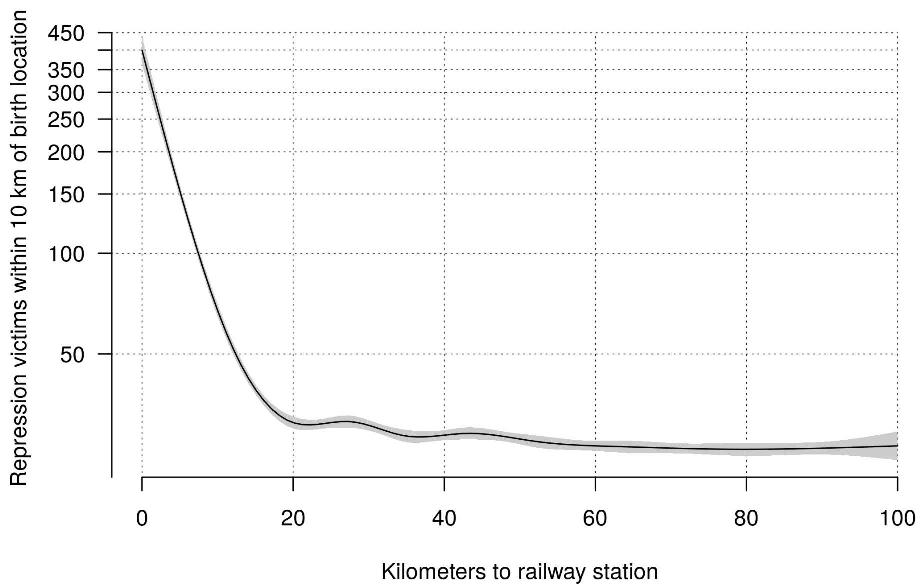
Table A7.18: ESTIMATES ADJUSTING FOR PEER EFFECTS.

behavior — for better or worse — varied with the behavior of their comrades-in-arms. This indicates that repression may not only have impacted the individual behavior of soldiers who were exposed to it but also, indirectly, the behavior of their peers.

A7.9. Railway access as an instrumental variable

Even if repression is exogenous on a small geographic scale, OLS estimates may be attenuated due to errors in the measurement of repression through archival sources. To correct for this bias, we use two-stage least squares (2SLS) as an additional estimation strategy. This approach exploits the industrial scale of Stalin's repression. Arrestees were transported to execution sites, prisons, and labor camps in large numbers and on short deadlines. This logistical burden fell mainly on railways (Kokurin and Petrov, 2000, 525). A third of the Great Terror's operating budget was earmarked for rail transport fees (Getty and Naumov, 2002, 478).

Motivated by these facts, we use access to railways, measured as the distance from a birth location to the nearest railway station, as an instrument for repression. The idea here is that otherwise similar locations may be exposed to varying levels of repression due to differing costs of accessing and transporting arrestees. One concern with this instrument is that it may be capturing economic development and population density. All our 2SLS estimations include distance to the nearest administrative center and nearest road junction, which approximate local development and density more directly than railways. Indeed, the Soviet railway system was built not to help foster local economic development



The estimated function $\hat{f}$ with 95% confidence bounds relating railway access to repression, adjusted for geographic covariates and grid cell fixed effects. Vertical axis is on logarithmic scale.

Figure A7.5: RAILWAY ACCESS AND REPRESSION

or connect population centers, but to help access resource-rich areas (Hopper, 1930).

To test whether birthplaces with better railway access saw more repression, all else equal, we fit the following semi-parametric regression:

$$\text{Repression}_j = f(\text{Raildist}_j) + \boldsymbol{\beta}'\boldsymbol{X}_j + \text{Cell}_{k[j]} + s(\text{lon}_j, \text{lat}_j) + \epsilon_j, \qquad (12)$$

where j indexes birth locations, *Raildist*$_j$ is distance from location j to the nearest railway station, and f is a smooth function approximated by cubic regression splines. As before, we add grid cell fixed effects, location level covariates, and a spatial spline. To ensure greater homogeneity, the 2SLS analyses use only locations within 100 km of rail stations.

Figure A7.5 shows a graph of the estimated function $\hat{f}$. The expected number of repression victims declines precipitously with distance to rail stations, even after accounting for road density, distance to administrative centers, and other covariates. A 10km higher proximity to a railway station increases the number of victims by a factor of two.

Note that we estimate function f at the level of birth location, not individual soldier, because this is the level at which the relationship between railway access and repression operates. Specification (12) helps us find an optimal transformation f of *Raildist*$_j$ that yields the strongest *linear* first stage relationship. In the 2SLS regression specified at the level of a soldier, we use the variable $\hat{f}(\text{Raildist}_{j[i]})$ as the instrument. The first stage is

$$\text{Repression}_{j[i]} = \alpha \cdot \hat{f}\left(\text{Raildist}_{j[i]}\right) + \boldsymbol{\beta}'\boldsymbol{X}_{ij} + \text{Cell}_{k[j]} + s(\text{lon}_j, \text{lat}_j) + \epsilon_i, \tag{13}$$

where $\boldsymbol{X}_{ij}$ includes both location-level and soldier-level covariates. In the second stage, we regress wartime individual outcomes on the predicted values of repression from (13).

The exclusion restriction behind our 2SLS strategy is that railway access impacted the future behavior of soldiers only through repression, and not some other channel outside the included covariates. One reason to doubt this assumption is that railways played a key role in the war effort: the front stretched 2,900 km from the Baltic to the Caspian Sea and motorized vehicles could only support operations up to 400 km (Davie, 2017). However, only a small fraction of RSFSR's railroad network fell inside areas of active military operations or behind German lines: 3.7% in an average month, and 16% cumulatively at any point in the war. The railway structure also changed significantly in 1941-1945, with 6,700 km of newly-built rail lines (Zickel, 1989, 552), which are not part of the instrument.

Another potential violation of the exclusion restriction has to do with railroads' use in military mobilization. While almost all military-age males were drafted, it is possible that someone living near railways faced different battlefield conditions by virtue of being drafted in the chaotic early months of the war, when incentives to flee and the odds of being killed were highest. However, the proximity of one's birthplace to railroads does not relate systematically to the timing of conscription, as we show in the next section.

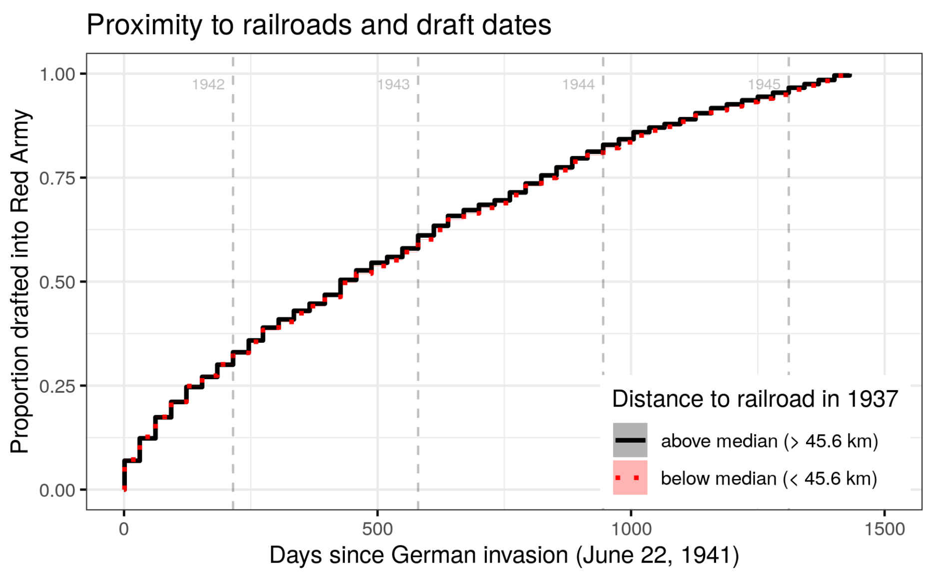
Railroad access and draft dates The validity of the railroad instrument depends in part on the assumption that railroad access at individuals' birth locations did not affect the battlefield conditions they faced upon being drafted. This assumption would be violated if, for instance, individuals living closer to railroads were drafted earlier in the war, during Germany's summer offensive of 1941 or before Stalin issued orders for stricter troop discipline.

To assess the plausibility of this scenario, Figure A7.6 reports non-parametric Kaplan-Meier estimates of the proportion of soldiers drafted by each day in the war.[15] The two curves correspond to soldiers born in locations with above- and below-median values of $\hat{f}\left(\text{Raildist}_j\right)$, corresponding to $\text{Raildist}_j = 45.6$km. The two curves overlap almost perfectly until about mid-1942, at which point they slightly diverge, with soldiers born closer to railroads being *less* likely to have been drafted by any given date. The two lines converge yet again in 1945. The median draft dates of soldiers in the two groups were just

[15]This analysis includes only individuals drafted between June 22, 1941 and May 9, 1945, for whom draft dates are available, with time precision at the daily level ($N = 5,924,878$, or 51% of full sample).

over a week apart – February 2, 1943 for soldiers born closer to railroads, and January 23, 1943 for those born further away. In sum, there is no evidence that the proximity of one's birth location to railroads systematically affected the timing of one's draft date.

Figure A7.6: KAPLAN-MEIER ESTIMATES OF CUMULATIVE PROPORTION DRAFTED.



Results of 2SLS analyses Table A7.19 reports 2SLS estimates for all outcomes of interest. The results here are consistent with those from OLS and FRDD in Table 2 of the main text. Soldiers exposed to more repression due to increased railroad access were more likely to be killed or wounded, less likely to flee, but also less likely to receive a decoration for valor.

The relatively large magnitude of 2SLS estimates may indicate violations of the exclusion restriction. In the next section, we conduct sensitivity analyses to assess how large these violations must be to invalidate our results (Conley, Hansen and Rossi, 2012).

Sensitivity analyses of the 2SLS exclusion restriction A key identifying assumption of our instrumental variable analyses is the exclusion restriction, which requires that our instrument (distance to nearest railroad) influence individual battlefield outcomes only through its effect on treatment (arrests). An especially concerning violation of this assumption would be one where – for some unobserved socio-economic, cultural or other reason – people living near railroads in 1937 were systematically more likely to die in battle, less likely to surrender or flee, and less likely to receive decorations. We now conduct an additional set of analyses to assess how severe possible violations of the exclusion

	KIA/WIA	Flee	MIA	POW	DDT	PUN	Medals
Model	2SLS (First-stage $\mathcal{F} = 99.1$)						
Coef. for Repression	3.3 (0.6)**	-2.6 (0.5)**	-2.5 (0.4)**	-0.2 (0.2)	0.03 (0.01)**	-0.1 (0.03)*	-2.2 (0.4)**
Mean Y	20.7	26	20.4	5.8	0.2	0.8	18
Birthplaces	145,294	145,294	145,294	145,294	145,294	145,294	145,294
Gridcells	5,656	5,656	5,656	5,656	5,656	5,656	5,656
Soldiers	9,645,257	9,645,257	9,645,257	9,645,257	9,645,257	9,645,257	9,645,257

Outcomes on percentage scale (0 to 100). Robust standard errors in parentheses, clustered by birth location and grid cell. All models include grid cell fixed effects, individual and birth location-level covariates. Observations weighted by record linkage probability. 2SLS analyses exclude birth locations > 100km from railroad. Significance levels (two-tailed): $^{\dagger}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$.

Table A7.19: TWO-STAGE LEAST SQUARES ESTIMATES.

restriction would need to be in order to overturn our 2SLS results. Following Conley, Hansen and Rossi (2012), we model these potential violations with an extension of our main two-stage specification,

$$y_i = \zeta \cdot \hat{f}\left(\text{Raildist}_j\right) + \gamma \cdot \ln\left(\widehat{\text{Repression}}_{j[i]} + 1\right) + \boldsymbol{\beta}'\boldsymbol{X}_{ij} + \text{Cell}_{k[i]} + s\left(\text{lon}_{j[i]}, \text{lat}_{j[i]}\right) + \epsilon_i$$
$$\ln\left(\text{Repression}_j + 1\right) = \alpha \cdot \hat{f}\left(\text{Raildist}_j\right) + \boldsymbol{\lambda}'\boldsymbol{X}_j + \text{Cell}_{k[j]} + s\left(\text{lon}_{j[i]}, \text{lat}_{j[i]}\right) + \epsilon_j$$

where $\hat{f}\left(\text{Raildist}_j\right)$ is the excluded (linearized) instrument, and ζ is a parameter capturing the size and direction of exclusion restriction violations. If there are no violations, $\zeta \equiv 0$.

Our sensitivity analysis employs Conley, Hansen and Rossi (2012)'s union of confidence intervals approach, which estimates the maximum value ζ can take such that the γ coefficient estimate remains statistically significant at the 95% level. Given a support region for ζ, $\mathfrak{Z}$, we draw a value $\zeta_0 \in \mathfrak{Z}$ and subtract $\zeta_0 \cdot \hat{f}\left(\text{Raildist}_j\right)$ from both sides of the second-stage equation:

$$\left(y_i - \zeta_0 \cdot \hat{f}\left(\text{Raildist}_j\right)\right) = \gamma \cdot \ln\left(\widehat{\text{Repression}}_{j[i]} + 1\right) + \boldsymbol{\beta}'\boldsymbol{X}_{ij} + \text{Cell}_{k[i]} + s\left(\text{lon}_{j[i]}, \text{lat}_{j[i]}\right) + \epsilon_i$$

We then employ the usual asymptotic approximations to obtain a 95% confidence interval for $\hat{\gamma}$, assuming that $\zeta = \zeta_0$. We construct these intervals for all points in $\mathfrak{Z} = [-5, 5]$.

The sign of ζ determines whether violations of the exclusion restriction are more likely to attenuate or inflate estimates of γ. By construction, $\hat{f}\left(\text{Raildist}_j\right)$ is increasing in proximity to railroads (i.e. larger values indicate that a location is closer to the railway). Exclusion restriction violations are therefore more likely to attenuate $\hat{\gamma}$ if $\zeta > 0$ for KIA/WIA (meaning that individuals born closer to the railroad are more likely to die or become wounded), $\zeta < 0$ for MIA/POW/DDT/Punished and for medals (implying that those born closer to railroads are less likely to have these outcomes). If ζ takes the opposite signs, then standard 2SLS regression underestimates the true effect of repression.

Table A7.20: 2SLS SENSITIVITY ANALYSES.

Outcome	$\max(\zeta)$	$\hat{\gamma}$ at $\max(\zeta)$	95% CI	$\zeta \cdot \hat{f}\left(\frac{sd(Z)}{2}\right)$	Mean Y
KIA/WIA	1.467	1.048	(0.002, 2.093)	2.715	21.722
Flee	-1.156	-0.857	(-1.712, -0.003)	-2.139	26
MIA	-1.168	-0.689	(-1.376, -0.003)	-2.161	20.463
DDT	0.005	0.022	(0.002, 0.042)	0.01	0.16
PUN	-0.007	-0.053	(-0.103, -0.002)	-0.013	0.808
Medal	-0.97	-0.714	(-1.428, -0.001)	-1.795	17.596

2SLS estimates of repression's effect (includes only results significant at 95% level in main analysis). Outcomes on percentage scale (0 to 100). Confidence intervals based on robust standard errors, clustered by birth location. All models include grid cell fixed effects, individual and birth location-level covariates. Observations weighted by record linkage probability.

Table A7.20 reports the results of these sensitivity analyses, including the maximum size ζ can take while maintaining a significant estimate of γ, along with the corresponding γ estimate and its 95% confidence region. Note that the table includes only those results, which we originally found to be significant at the 95% level in the main analyses. We also report the implied effect that a median-to-zero decrease in distance to railroad (38km to 0km) would have on y at each critical value of ζ.

In the case of KIA/WIA, for example, the critical value of ζ is 1.5. In order to overturn the positive effect of repression on this outcome, a median-to-zero decrease in distance from the railroad would need to increase one's chances of dying or becoming wounded by at least $1.5 \cdot \hat{f}(-38 \text{ km}) = 2.7$ percent. The magnitude of this violation would therefore need to be quite substantial, considering that the mean value of KIA/WIA is 21.7 percent. These results suggest that – for most battlefield outcomes, and especially KIA/WIA, MIA and Glory Medals – the effect of repression is robust to reasonably-sized violations of the exclusion restriction. Other results, such as the odd positive coefficient for DDT, appear to be highly sensitive to these violations, with $\zeta < .01$.

A7.10. Expanded sample analysis: Ukrainian SSR

Table A7.21 replicates the analyses from Table 2 of the main text, using an expanded sample that includes soldiers from both RSFSR and UkrSSR. The results here are consistent with those we report in the main text. Soldiers exposed to more repression were more likely to be killed or wounded, less likely to flee the battlefield, but also less likely to receive a decoration for valor.

	KIA/WIA	Flee	MIA	POW	DDT	PUN	Medals
Model				OLS			
Coef. for Repression	0.2 (0.1)**	-0.1 (0.04)	-0.1 (0.03)**	0.03 (0.02)	0.003 (0.002)$^{\prime}$	2e-04 (0.003)	-0.3 (0.05)**
Mean Y	21.1	25.7	20	5.9	0.2	0.8	18.3
Birthplaces	201,221	201,221	201,221	201,221	201,221	201,221	201,221
Gridcells	12,257	12,257	12,257	12,257	12,257	12,257	12,257
Soldiers	13,808,303	13,808,303	13,808,303	13,808,303	13,808,303	13,808,303	13,808,303
Model				FRDD (First-stage $\mathcal{F} = 15.4$)			
Coef. for Repression	1.2 (0.6)$^{\prime}$	-0.4 (0.3)	-0.6 (0.2)**	0.2 (0.2)	-0.01 (0.01)	-0.02 (0.02)	-0.9 (0.3)**
Mean Y	20.5	25.9	19.8	6.3	0.2	0.8	17.9
Birthplaces	47,166	47,166	47,166	47,166	47,166	47,166	47,166
Gridcells	2,575	2,575	2,575	2,575	2,575	2,575	2,575
Soldiers	3,791,800	3,791,800	3,791,800	3,791,800	3,791,800	3,791,800	3,791,800

Outcomes on percentage scale (0 to 100). Robust standard errors in parentheses, clustered by birth location and grid cell. All models include grid cell fixed effects, individual and birth location-level covariates. Observations weighted by record linkage probability. FRDD analyses exclude locations in non-matched regions and > 50km from regional borders. Significance levels (two-tailed): $^{\dagger}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$.

Table A7.21: REANALYSIS WITH EXPANDED SAMPLE (RSFSR + UkrSSR).

A8. QUALITATIVE EVIDENCE ON DISCRIMINATION

The current section considers qualitative evidence in favor and against the alternative interpretation that our findings reflect patterns of discrimination against soldiers from highly-repressed areas, rather than the effect of repression exposure on soldiers' behavior.

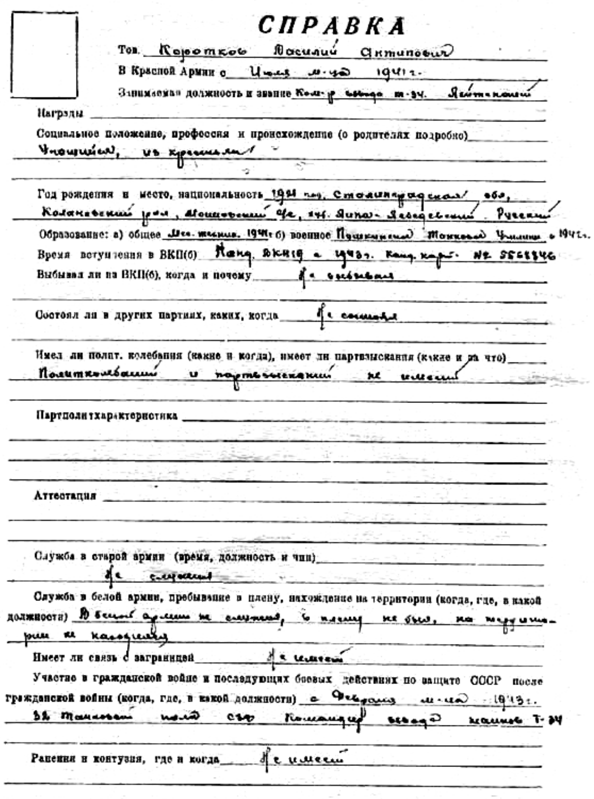
A8.1. Information commanders had about subordinates

We begin by considering whether military commissariats and unit commanders had access to sufficient information to facilitate assignment discrimination — defined as the selective assignment of soldiers from heavily repressed areas to specific units or tasks. This discrimination could conceivably be in either direction. If soldiers from repressed areas were assigned to more dangerous jobs, then this would help explain the positive association between repression exposure and battlefield deaths and injuries. If soldiers from these areas were assigned to rear duties, away from the frontline, this would help explain the negative association between repression exposure and flight.

In order for either type of assignment discrimination to take place, military commissariats (who assigned soldiers to units) and unit commanders (who assigned soldiers to tasks) would have needed information not only about soldiers' personal backgrounds and arrest records, but also *contextual information* about political arrests in the vicinity of each soldier's birth. This is because our treatment variable captures local geographic exposure to the terror, rather than individual experiences with the secret police.

The documents in Figures A8.7, A8.8 and A8.9 show examples of a soldier's Service Record Card File (sourced from the Central Archive of the Ministry of Defense), which were initially created by military commissariats during enlistment and used by unit commanders throughout soldiers' service period. The documents illustrate that military authorities had information about soldiers' personal backgrounds (date and place of birth, nationality, social and marital status, education, place of conscription, awards, party and military registration cards), as well as indicators of political loyalty like party membership, service in the counter-revolutionary White Army during the Civil War, and "foreign connections." The scope of this information is similar to — in some respects, narrower than — that used for background checks and security clearance investigations in Western militaries and security agencies. This information would have been sufficient as a basis for discrimination based on individual characteristics and background. However, what these documents do not contain is information on the political loyalties or arrest records of *other citizens* residing near the soldier's birthplace — the type of contextual information that would have been necessary for authorities to discriminate on the basis of the local environment in which a soldier had been born and raised.

Figure A8.7: Service Record Case File (example 1)



СПРАВКА

Тов. Коротков Василий Антипович

В Красной Армии с Июля м-ца 1941 г.

Занимаемая должность и звание Ком-р взвода т-34. Лейтенант

Награды

Социальное положение, профессия и происхождение (о родителях подробно) Учащийся, из крестьян

Год рождения и место, национальность 1921 год, Сталинградская обл, Калачевский р-н, Местовский с/с, х. Лебедевский. Русский

Образование: а) общее Мех.-технич. 1941 г. б) военное Пушкинское Танковое Училище в 1942 г.

Время вступления в ВКП(б) Канд. ВКП(б) с 1943 г. Канд. карт. № 5568846

Выбывал ли из ВКП(б), когда и почему Не выбывал

Состоял ли в других партиях, каких, когда Не состоял

Имел ли полит. колебания (какие и когда), имеет ли партвзыскания (какие и за что) Политколебаний и партвзысканий не имеет

Партполитхарактеристика

Аттестация

Служба в старой армии (время, должность и чин) Не служил

Служба в белой армии, пребывание в плену, нахождение на территории (когда, где, в какой должности) В белой армии не служил, в плену не был, на территории не находился

Имеет ли связь с заграницей Не имеет

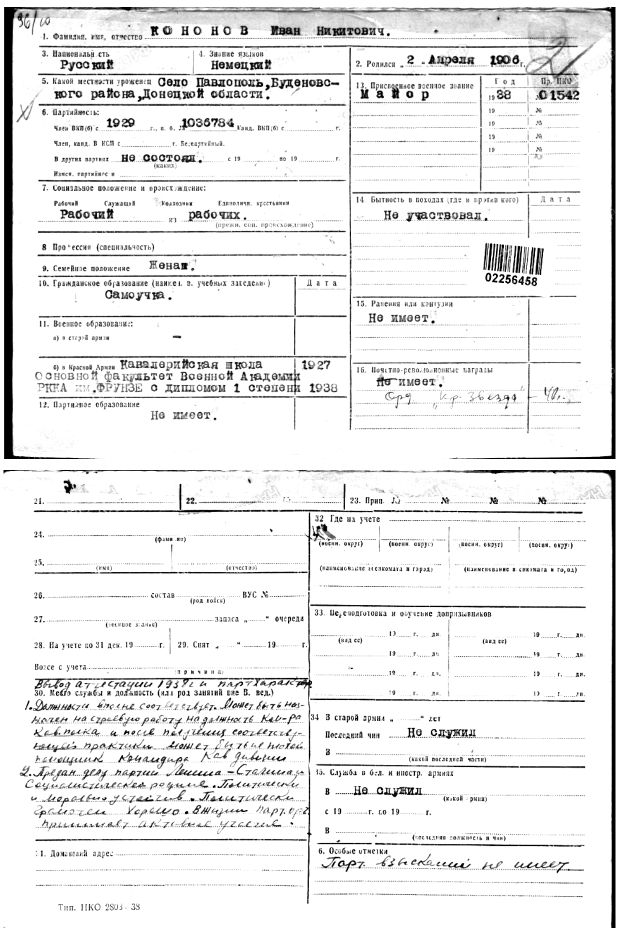
Участие в гражданской войне и последующих боевых действиях по защите СССР после гражданской войны (когда, где, в какой должности) с Февраля м-ца 1943 г. 32 танковый полк С3Ф Командир взвода машин Т-34

Ранения и контузия, где и когда Не имеет

English translation

Comrade: *Korotkov Vasiliy Antipovich*
In Red Army since: *July 1941*
Current post and rank: *T-34 tank platoon commander, lieutenant*
Decorations: —
Social status, profession and background (parents' details): *from a peasant family*
Year and place of birth, nationality: *year 1921, Stalingrad province, Kalachevskiy distrit, Mestovskiy locality, Lebedevsk hamlet (khutor), Russian*
Education - a) general: *mechanical-technical in 1941* b) military: *Pushkin Tank School in 1942*
VKP(b) [Communist party] membership start date: *since 1939, Communist card number: 5568846*
Withdrawal from VKP(b), when and why: *no withdrawal*
Membership in other parties, which ones, when: *no membership*
History of political dithering (what kind and when), party disciplinary actions (what kind and what for): *no political dithering or party disciplinary actions*
Party political assessment: —
Performance review: —
Service in old [Tsarist] army (time, post, rank): *no service*
Service in White Army, captivity, place of deployment (when, where, in what capacity): *never served in the White Army, never was in captivity, and never was deployed in the indicated territories*
Foreign connections: *no foreign connections*
Participation in civil war and subsequent military operations in defense of USSR after civil war (when, where, in what capacity): *since February 1943, served as the commander of T-34 tank platoon*
Injuries and contusions, where and when: *none*

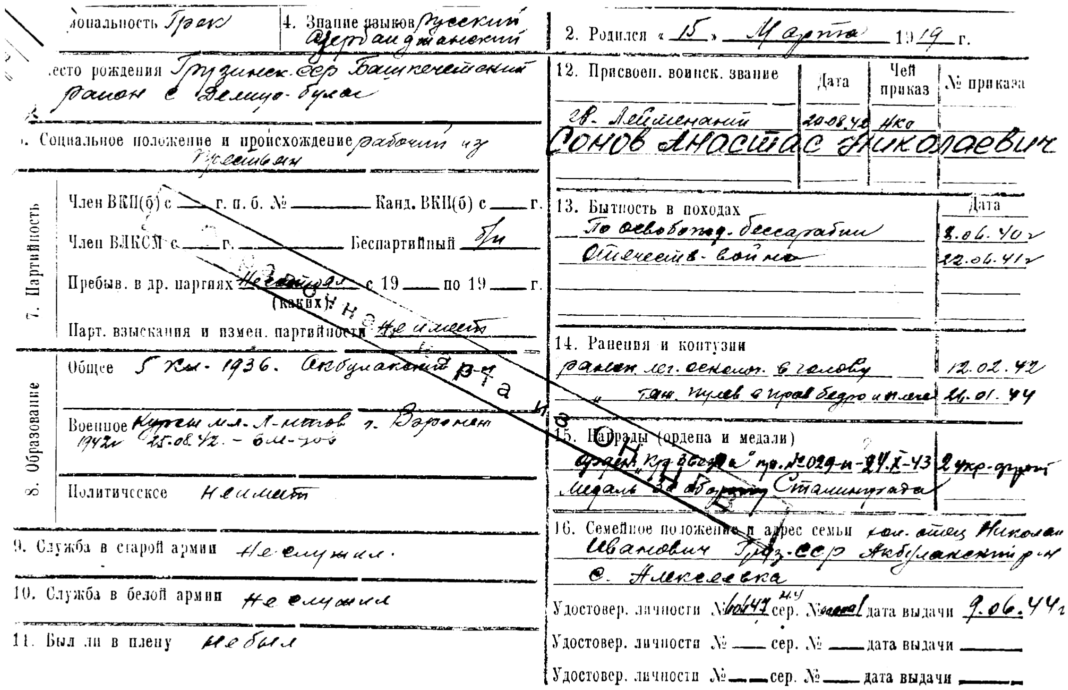
Figure A8.8: SERVICE RECORD CASE FILE (EXAMPLE 2)


36/10
1. Фамилия, имя, отчество КОНОНОВ Иван Никитович.
3. Национальность Русский
4. Знание языков Немецкий
2. Родился „2" Апреля 1906 г.
5. Какой местности уроженец Село Павлополь, Буденовского района, Донецкой области.
13. Присвоенное военное звание Майор — Год 1938 — Пр. НКО № 01542
6. Партийность: Член ВКП(б) с 1929 г., п. б. № 1036784
В других партиях не состоял.
7. Социальное положение и происхождение: Рабочий из рабочих.
14. Бытность в походах (где и против кого) Не участвовал.
8. Профессия (специальность)
9. Семейное положение Женат.
10. Гражданское образование (наимен. в. учебных заведении) Самоучка.
11. Военное образование: а) в старой армии —
б) в Красной Армии Кавалерийская школа 1927 Основной факультет Военной Академии РККА им. ФРУНЗЕ с дипломом 1 степени 1938
15. Ранения или контузии Не имеет.
16. Почетно-революционные награды Не имеет.
12. Партийное образование Не имеет.
34. В старой армии — Последний чин Не служил
35. Служба в бел. и иностр. армиях в Не служил

English translation

Surname, first name, patronymic: *Kononov Ivan Nikitovich*
DOB: *April 2, 1906*
Nationality: *Russian*
VKP(b) [Communist party] membership start date: *since 1929. Communist card number: 1036784*
Membership in other parties: *no membership*
Change of party membership: *none*
Social status and background: *worker from a family of workers*
Profession (specialty): *—*
Marital status: *married*
General education: *self-educated*
Military education - a) in old [Tsarist] army: *none*
b) in Red Army: *Cavalry School in 1927. The main department of the Military Academy of the Red Army named after Frunze with a diploma of the first degree in 1938*
Party education: *none*
Military rank, year, order no: *major, 1938, Order No 1542*
Presence in campaigns (where and against whom: *not participated*
Injuries and contusions: *none*
Honorary-revolutionary awards: *none (1 red. Order of Red Banner in 1940(-))*
Upshot of the Performance Review of 1938 and party political assessment: *Quite relevant for the position. He may be assigned to combat work to hold the position of a Commander of a Cavalry Regiment, and after receiving appropriate practice, he may make a suitable assistant to the Commander of a Cavalry Division. Loyal to the work of the Lenin-Stalin's party and to the Socialist Motherland. Politically and morally stable. Politically well-literate. He takes an active part in the life of the party organization.*
Home address: *—*
Service in old [Tsarist] army: *no service*
Service in White Army or other foreign armies: *no service*
Special notes: *no party disciplinary actions*

Figure A8.9: SERVICE RECORD CASE FILE (EXAMPLE 2)



...ональность Грек
4. Знание языков Русский, Азербайджанский
2. Родился « 15 » Марта 1919 г.
...есто рождения Грузинск. ССР Башкечетский район с. Демир-булаг
12. Присвоен. воинск. звание | Дата | Чей приказ | № приказа
Лейтенант | 20.08.42 | НКО
СОНОВ АНАСТАС НИКОЛАЕВИЧ
...Социальное положение и происхождение рабочий из крестьян
7. Партийность
Член ВКП(б) с ___ г. п. б. № ___ Канд. ВКП(б) с ___ г.
Член ВЛКСМ с ___ г. ___ Беспартийный б/п
Пребыв. в др. партиях (каких) Не состоял с 19__ по 19__ г.
Парт. взыскания и измен. партийности Не имеет
13. Бытность в походах | Дата
По освобожд. Бессарабии | 8.06.40 г.
Отечеств. война | 22.06.41 г.
8. Образование
Общее 5 кл. 1936. Акбулакский р-н
Военное Курсы мл. л-тов г. Воронеж 1942 г. 25.08.42. – 6 м-цев
Политическое Не имеет
14. Ранения и контузии
ранен лег. осколк. в голову | 12.02.42
тяж. пулев. в прав. бедро и плечо | 22.01.44
15. Награды (ордена и медали)
орден «Кр. Звезда» пр. №029-н-24.X-43 2 Укр. фронт
медаль «За оборону Сталинграда»
9. Служба в старой армии Не служил
10. Служба в белой армии Не служил
11. Был ли в плену Не был
16. Семейное положение и адрес семьи хол. отец Николай Иванович Груз. ССР Акбулакский р-н с. Алексеевка
Удостовер. личности № ___ сер. № ___ дата выдачи 9.06.44 г.
Удостовер. личности № ___ сер. № ___ дата выдачи ___
Удостовер. личности № ___ сер. № ___ дата выдачи ___

English translation

Last name, first name, patronymic: *Sonov Anastas Nikolaevich*
DOB: *15 March, 1919*
Nationality: *Greek*
Foreign languages: *Russian and Azerbaijani*
Place of birth: *Georgian SSR, Dmaliss district (Bashkichet), Demirbulag village*
Social status and background: *worker from a family of peasants*
VKP(b) [Communist party] membership start date: *no party membership*
Membership in other parties: *no membership*
Change of party membership or party disciplinary action: *none*
General education: *until 5th grade in 1936 in Akbulak district*
Military education: *Cavalry School of Voronezh in October 1942*
Party education: *none*
Military rank, year, order no: *major, 1938, Order No 1542*
Service in old [Tsarist] army: *no service*
Service in White Army or other foreign armies: *no service*
Prisoner of war status: *none*
Military rank, year: *lieutenant, 20.08.1942*
Presence in campaigns (where and against whom): *for the liberation of Bessarabiya in 18.04.1942 and Great Patriotic War in 22.06.1942*
Wounds or shell shocks: *light wound to the head in 12.02.1942 and heavily wounded with a bullet to the right thigh and shoulder in 22.01.1944 in the second Ukrainian front*
Awards (orders and medals: *Order of Red Banner in 24.10.1943 and Medal for the Defense of Stalingrad*
Marital status and Address of the family: *married, father - Nikolay Inanovich, lives in Georgian SSR, Akbulak district, Alekseevka village*

A8.2. Provision of arms and ammunition to units

We now take a closer look at variation in equipment quality and supplies across the Red Army and over time. As we show below, using evidence from Soviet archives, there was significant geographic and temporal variation in the supply of arms and ammunition to the front — due largely to the pace and location of major military operations — but few signs of systematic discrimination across operational units.[16]

Political authorities in Moscow had approval authority over the distribution of materiel across Fronts — the largest military formations in the Red Army, comprising three to five armies each — but little visibility over its subsequent distribution across armies, divisions, regiments and battalions.[17] The Rear Services sections overseeing supply and maintenance across these operational-level units had neither the discretionary authority, nor the information needed to selectively withhold support from specific units on the basis of (average) pre-war repression levels. While it is certainly possible that some units were nonetheless chronically under-supplied — by design or by accident — the resulting variation can be captured with unit-level fixed effects.

Process and Procedures of Provision. Every month, the General Staff issued a directive, which indicated which Front, in which sequence and on which date would receive ammunition of a certain amount. On the basis of these instructions, along with "report cards" and application documents from the Fronts, the Main Artillery Directorate (GAU) planned to send ammunition to the troops of the active army. The main sources of variation included supply availability at central bases and warehouses, industrial production capacity, and the security and needs of the Fronts. When the GAU did not have the necessary resources, it, in agreement with the General Staff, made adjustments to the established volume of ammunition supply to prioritize the support of frontline units that needed additional ammunition. The monthly supply plan would be considered and signed by the Commander of Artillery of the Soviet Army and the Chief of the GAU, and submitted to the Supreme Commander (Stalin) for approval.

On the basis of this plan, the organizational and planning department of the GAU reported data on the release and dispatch of ammunition to the Fronts and gave orders to the Ammunition Supply Department. The latter, together with the Central Administration of Military Communications (TsUPVOSO), prepared the shipments within five days and informed the Fronts of the transport numbers, locations and dates of their dispatch.

[16] All of the official figures and statistics listed in this section are from (Kurkotkin, 1975).

[17] Front-level logistics reports rarely mentioned units below the army level (e.g., Central Archive of the Ministry of Defense of the Russian Federation (TsAMO RF), collection 240, series 2824, case 1, page 37-58).

As a rule, the dispatch of transports with ammunition to the Fronts began on the 5th and ended on the 25th of each month. This method of planning and sending ammunition to the Fronts from the central bases and warehouses remained until the end of the war.

The issues of planning, organizing and implementing rail and water transportation and restoring and blocking railway communications were managed by the Military Communications Department of the Soviet Army, subordinate to the Chief of the General Staff. The headquarters of the military districts (Fronts) and armies had departments of military communications directly subordinate to the chief of staff. The management of military automobile (highway and dirt) roads, the organization and implementation of the supply of materiel to the troops by automobile and horse-drawn vehicles were concentrated in the rear departments. The corresponding heads of the armed forces and services were responsible for the supply of troops with materiel, technical, medical and veterinary support. The Deputy (Assistant) Chief of Staff for Logistics was tasked with directing the work of the chiefs of the military branches and services for providing and servicing the troops. The supply of troops with materiel in peacetime was carried out according to the scheme: center - district - division - unit. The presence of a divisional link in the supply scheme made it possible in the event of war to quickly switch to the supply scheme center - front - army - division - unit.

Maintenance of Weapons The choice of specific maintenance methods and procedures depended on the nature of the operations being carried out, their scope, the pace of the advance of the troops, and the availability of forces and means for the restoration of armored vehicles. Starting in the second half of the war, the basic principle of organizing and implementing the technical support of troops relied on bringing repair and evacuation teams from rear areas as close as possible to the frontlines. These teams evacuated broken-down armored equipment and machinery to the collection points of emergency vehicles, which were organized in areas with the largest accumulation of broken military and transport equipment.

Although repair facilities were often located in rear areas, frontline repair centers did exist. Usually, these repair centers comprised two separate tank repair battalions, with three or four mobile tank repair bases, evacuation facilities (one or two evacuators and an evacuation squad), assembly points for emergency vehicles, assembly and distribution points for the dismantling of irrecoverably damaged tanks, and mobile repair and assembly points. In the event that the Front advanced in two separate directions, two frontline repair centers would be created. To ensure the rapid and efficient repair of armored vehicles in conditions of high operational tempo, all repair and evacuation centers remained under rigid centralized control.

Temporal and Spatial Variation in Provision of Arms to Frontline Units

First period. In the first weeks of the Great Patriotic War (June-July 1941), the Soviet army suffered significant losses of weapons and ammunition, particularly the stockpiles accumulated by border military districts in the prewar years. The supply of arms and ammunition by military factories in the south of the country effectively ceased, as most artillery and munitions factories were evacuated from threatened areas (e.g. the Donbas) to locations east of the Urals. These developments greatly complicated the production of weapons and ammunition, and their provision to the army and new military formations.

Bureaucratic shortcomings also negatively impacted the resupply of troops. The GAU did not always accurately know the state of security of the troops at the front, and strict accounting standards for this service had not been established before the war. Authorities completely reorganized the GAU in late 1941, formed a new Directorate for the Supply of Ground Artillery Weapons, created a new post of Chief of Logistics of the Soviet Army, and introduced urgent reports on ammunition and weapons systems. This reorganization facilitated closer cooperation between the GAU, other supply services, and the Central Directorate of Military Communications.

In the second half of 1941, as the national economy moved onto a war footing and as more assembly line workers, scientists, engineers and technicians joined the labor force, the Soviet military industry was able to increase weapons production. This included 30,200 guns (including 9,900 76-mm and larger caliber), 42,300 mortars (including 19,100 82-mm caliber and larger), 106,200 machine guns, 89,700 assault rifles, 1.6 million rifles and carbines, and 62.9 million shells, bombs and mines. Yet since these delivery of weapons and ammunition only partially covered the losses of 1941, the supply situation remained tense. It took a huge effort by the military industry, rear services, and the GAU to satisfy the needs of the Fronts in weapons and especially ammunition. By December 1941, the availability of armaments on the Western Front increased from 50-80% of initial stockpiles to 370-640% for some weapon types.

In the second quarter of 1942, after the start of operations in additional military factories, especially in the Urals, Western and Eastern Siberia, and Kazakhstan, the supply of troops with weapons and ammunition began to noticeably improve. Overall, in 1942, the military industry supplied the front with tens of thousands of guns of 76 mm and larger caliber, over 100,000 mortars (82-120 mm), and millions of shells and mines. That year, the main and most difficult task was to provide weapons for units operating in the Stalingrad region, in the large bend of the Don and in the Caucasus.

The consumption of ammunition in the defensive battle near Stalingrad was very high. Due to a huge volume of rail traffic, transports with ammunition moved slowly and were unloaded at the stations of the frontline railway section (Elton, Dzhanybek, Kaisatskaya, Krasny Kut). To deliver ammunition to the troops faster, the Stalingrad Front Artillery Supply Directorate was assigned two automobile battalions, which managed to transport over 500 wagons of ammunition in an extremely limited time frame.

The provision of weapons and ammunition to the Stalingrad Front was further complicated by Germany's continuous bombardment of supply dumps and river crossings on the Volga. As a result of enemy air raids and shelling, artillery depots often had to change their locations, and trains were unloaded only at night. To disperse supply trains, ammunition was sent to army warehouses and their departments near the railway in quick service trains, 5-10 wagons each, and then to the troops in small automobile columns (10-12 cars each), usually following different routes. This method of transportation ensured the safety of ammunition, but also lengthened the time needed for delivery.

The supply of arms and ammunition to Fronts operating in the Volga and Don regions during this period was less complicated and laborious. During the defensive battle near Stalingrad, all three Fronts (Stalingrad, Don, and South-West) received 5,388 wagons of ammunition, 123,000 rifles and assault rifles, 53,000 machine guns, and 8,000 guns.

Simultaneously with the fighting that unfolded on the banks of the Volga and in the steppes of the Don, the battle for the Caucasus began in a vast area from the Black Sea to the Caspian. Supplying the Transcaucasian Front (Northern and Black Sea Groups) with weapons and ammunition was more complicated than near Stalingrad. The supply of weapons and ammunition proceeded in a roundabout way, from the Urals and Siberia through Central Asia and across the Caspian Sea. Separate transports went through Astrakhan, Baku and Makhachkala. A long route for transports with ammunition (5170-5370 km) and the need for repeated transshipment of goods from rail to water, water to rail, and rail to road and mountain passes, greatly increased delivery times to frontline and army warehouses. For example, transport No. 83/0418, sent on September 1, 1942 from the Urals to the Transcaucasian Front, arrived at its destination only on December 1. Transport No. 83/0334 traveled from Eastern Siberia to Transcaucasia via a 7027 km distance. Despite huge distances and delays, transports with ammunition regularly went to the Caucasus. During six months of hostilities, the Transcaucasian Front received about 2,000 wagons of ammunition.

It was very difficult to deliver ammunition from front and army warehouses to troops defending the mountain passes of the Caucasus Range. The main means of transportation here were army and military pack companies. In the 20th Guards Rifle Division, which was defending the Belorechensk direction, shells were delivered from Sukhumi to Sochi by sea, then to the divisional warehouse by road, and to regimental combat nutrition points by pack transport. For the 394th Infantry Division, ammunition was delivered by U-2 aircraft from the Sukhumi airfield. Ammunition was delivered in this way for almost all divisions of the 46th Army.

There was some locally-based production in the Caucasus region. Up to 30 heavy machinery plants and workshops in Georgia, Azerbaijan and Armenia were involved in the manufacture of hand grenades, mines and shells of medium caliber. From October 1, 1942 to March 1, 1943, they manufactured 1.3 million cases of hand grenades, 1 million mines and 226 thousand cases of shells. In 1942, the local industry of Transcaucasia manufactured 4,294 50-mm mortars, 688 82-mm mortars, and 46,492 machine guns.

The delivery of arms and ammunition to the besieged city of Leningrad was extremely difficult, which increased reliance on local production. From September until the end of 1941, the city's industrial complex provided the Leningrad Front with 12,085 assault rifles and signal pistols, 7,682 mortars, 2,298 artillery pieces and 41 rocket launchers. In addition, they produced 3.2 million shells and mines, over 5 million hand grenades. Leningrad supplied weapons to other Fronts as well. As the Germans were advancing toward Moscow in November 1941, the Military Council of the Leningrad Front sent 926 mortars and 431 76-mm regimental guns to Moscow. Disassembled guns were loaded onto aircraft and sent to the Cherepovets station, where an artillery shop assembled them, and loaded them onto trains headed for Moscow. In the same period, Leningrad sent 39,700 rounds of 76-mm armor-piercing ammunition to Moscow by air.

Second period. Provision of the army with weapons and ammunition remained difficult in the second period of the war, which began with a powerful Soviet counteroffensive near Stalingrad in November 1942. By the beginning of the counteroffensive, the Southwestern, Don and Stalingrad Fronts had 30,400 guns and mortars, including 16,755 units of 76 mm caliber and above, about 6 million shells and mines, 380 million rounds of ammunition for small arms, and 1.2 million hand grenades. There was a continuous supply of ammunition from GAU warehouses for the duration of the counteroffensive. From November 19, 1942 to January 1, 1943, the Stalingrad Front received 1,095 wagons of ammunition, the Don Front (from November 16, 1942 to February 2, 1943) – 1,460 wagons, the South-West (from November 19, 1942 to January 1, 1942) – 1090 cars and the Voronezh Front (from December 15, 1942 to January 1, 1943) – 278 cars. Between November 1942 and January 1943, the four Fronts received 3,923 carloads of ammunition.

Total consumption of ammunition in the Battle of Stalingrad, starting from July 12, 1942, reached 9539 wagons and was unparalleled in the history of warfare. This amounted to a third of the ammunition consumption of the entire Russian army during the First World War and twice the consumption of ammunition by both sides near Verdun.

Table A8.22: INCREASE IN WEAPONRY SUPPLY BETWEEN 1942-1943.

Weapons	1942	1943
	in thousands	
Rifles	2113,6	3151,4
Assault rifles	54,3	556,2
Machine Guns (light and medium)	54,3	123,0
Mortars	10,5	57,0
Guns of all calibers	13,2	42,7

The volume of deliveries of weapons and ammunition increased again during preparations for the Battle of Kursk. The large concentration of weapons and troops on the Kursk Bulge, and the intensity of hostilities in the planned offensive operations, required an increase in supply. Between March and July of 1943, GAU warehouses supplied the Fronts with more than a half million rifles, 31.6 thousand light and medium machine guns, 520 heavy machine guns, 21.8 thousand anti-tank rifles, 12,326 guns and mortars. In April-June 1943, the Central, Voronezh and Bryansk Fronts received over 4.2 million shells and mines, about 300 million rounds of small arms ammunition and almost 2 million hand grenades (over 4 thousand wagons). During the battle itself, the Fronts received another 4,781 wagons (over 119 full-weight trains) of various types of ammunition from central bases and warehouses. The average daily supply was 51 wagons to the Central Front, 72 wagons to the Voronezh Front, and to 31 wagons to the Bryansk Front.

Third period. In the final period of the war, after the Soviet victory in Kursk in August 1943, the supply situation improved significantly. The bases and warehouses of the GAU had accumulated significant stocks of guns, mortars, and especially small arms — permitting a slight decrease in the production of small arms and ground artillery guns. If in 1943 the military industry supplied the Soviet Army with 130,300 guns, this number declined to 122,500 thousand in 1944. Deliveries of rocket launchers also decreased (from 3,330 in 1943 to 2,564 in 1944). The production of tanks and self-propelled guns continued to grow (29,000 in 1944 against 24,000 in 1943).

Due to high consumption, the supply of ammunition continued to be tight, especially for shells of 122 mm caliber and above. Total stocks of these munitions had decreased by 670,000 for 122-mm rounds, by 1.2 million for 152-mm shells and by 172,000 for 203-mm shells. Given the scarcity of shells on the eve of decisive offensive operations, the Politburo and the State Defense Committee tasked the military industry with radically increased production targets for all types of ammunition in 1944. Following this decision, the production of ammunition significantly increased compared to 1943: especially 122-mm and 152-mm shells, but also 76-mm (by 3,064 thousand, 9%), M-13 (by 385,500, 19%), and M-31 shells (by 15,200, 4%). This made it possible to provide Soviet troops with all types of ammunition for offensive operations.

On the eve of the Korsun-Shevchenkovsky offensive operation, the First and Second Ukrainian Fronts had about 50,000 guns and mortars, 2 million rifles and assault rifles, 10,000 machine guns, 12.2 million shells and mines, 700 million ammunition for small arms and 5 million hand grenades. During the operation, these Fronts received more than 1,300 wagons of all types of ammunition, with no interruptions in supply. However, due to the early spring thaw on military roads and supply routes, the movement of road transport became impossible, and the Fronts began to experience great difficulties in transporting ammunition to the troops and to artillery firing positions.

To provide ammunition for tank formations of the 1st Ukrainian Front, advancing in the operational depth of the Germans' defense, the state resorted to using of Po-2 aircrafts. On February 7 and 8, 1944, from the Fursy airfield, the state delivered 4.5 million rounds of ammunition, 5.5 thousand hand grenades, 15 thousand 82- and 120-mm mines and 10 thousand 76- and 122 mm shells. Every day, 80-85 aircraft delivered ammunition to tank units, making three to four flights a day. In total, the First Ukrainian Front received more than 400 tons of ammunition by aircraft.

The preparation and conduct of the Belarusian offensive operation, one of the largest strategic operations of the Great Patriotic War, required a huge amount of weapons and ammunition. Between May and July 1944, 6,370 guns and mortars, over 10,000 machine guns and 260,000 rifles were supplied to fully equip the troops of the First Baltic, First, Second and Third Belorussian Fronts. Such a high supply of ammunition had no precedent in previous offensive operations on a strategic scale. To send weapons and ammunition to the Fronts, the bases, warehouses and arsenals of the People's Commissariat of Defense (NKO) operated at maximum capacity. However, during the Belarusian operation, a rapid separation of troops from their bases, the wooded and swampy terrain, off-road conditions, and slow rates of restoration of damaged railway communications, complicated the supply of ammunition. Road transport was under great pressure, and could not by itself cope with the huge volume of supplies coming from the rear.

The dispersion of ammunition stocks along the frontline and in depth also had a negative effect. For example, on August 1, 1944, two warehouses of the 5th Army of the Third Belorussian Front were located at six points at a distance of 60 to 650 km from the frontline. Several armies in the Second and First Belorussian Fronts faced a similar situation. The advancing units could not carry all the stocks of ammunition they had accumulated during the preparation of the operation. The military councils of the Fronts and armies allocated a large number of motor vehicles to collect and deliver the ammunition that remained in the rear. For example, the Military Council of the Third Belorussian Front allocated 150 vehicles for this purpose, and the Head of Logistics of the 50th Army of the Second Belorussian Front allocated 60 vehicles and a working company of 120 people. By the end of July 1944, ammunition stocks were located at 85 different points for the Second Belorussian Front's, and at 100 points for the First Belorussian Front. The command was forced to transfer them by aircraft.

The consumption of ammunition in the Lvov-Sandomierz and Brest-Lublin offensive operations was also significant. During July and August, the First Ukrainian Front used up 4,706 wagons of ammunition, and the First Belorussian Front expended 2,372 wagons of ammunition. As in the Belarusian operation, the supply of ammunition was fraught with serious difficulties due to the high pace of advance, the large separation from artillery depots, poor road conditions, and the large volume of supplies on roadways.

During the offensive operations of 1945, there were no particular difficulties in providing the troops with weapons and ammunition. As of January 1, 1945, the total stocks of ammunition increased as compared to 1944: for mines – by 54%, for anti-aircraft artillery shells – by 35%, for ground artillery shells – by 11%. Thus, in the final period of the war between the Soviet Union and Nazi Germany, not only were the needs of the troops of the active army fully met, but it was also possible to create additional stocks of ammunition in front and army warehouses.

The beginning of 1945 was marked by two major offensive operations — East Prussian and Vistula-Oder. Troops were fully provided with weapons and ammunition during their preparations, and the presence of a well-developed network of railways and highways alleviated serious supply difficulties during the battles. The East Prussian operation, which lasted about three months, saw the largest consumption of ammunition in the entire Great Patriotic War. During its course, the troops of the Second and Third Belorussian Fronts used 15,038 wagons of ammunition (5,382 wagons in Vistula-Oder).

In terms of the pace and intensity of the supply effort, the Berlin offensive operation surpassed all offensive operations of the Great Patriotic War. During preparations, the First Belorussian and First Ukrainian Fronts received over 2,000 guns and mortars, almost 11 million shells and mines, over 292.3 million cartridges and about 1.5 million hand grenades. By the beginning of the operation, they had over 2 million rifles and assault rifles, over 76,000 machine guns and 48,000 other guns and mortars. From April 16 to May 8, 1945, 7.2 million (5,924 wagons) of shells and mines were delivered to the Fronts, which (taking into account stocks) fully covered their needs and made it possible to create a reserve of them by the end of the operation.

In general, the supply of ammunition to the front in 1945 significantly exceeded the level of previous years of the Great Patriotic War. In the fourth quarter of 1944, 31,736 wagons of ammunition (793 trains) arrived at the front, compared to 44,041 wagons (1,101 trains) in the first four months of 1945.

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