The Value of a Statistical Life in a Dictatorship: Evidence from Stalin*

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Abstract

We examine the value of a statistical life (VSL) in interwar Soviet Union. Our approach requires to address the preferences of Stalin. We model these on the basis of the policy of statistical repression, which was an integral part of the Great Terror. We use regional variation in the victims generated by this policy to structurally estimate the value that Stalin would have been willing to accept for a reduction in citizens' fatality risk. Our estimate of this value is about 43,000 USD, roughly 6% of the VSL estimate in 1940's US and 29% of the VSL estimate in modern India.

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1. Introduction

Any complex society confronts a trade-off between economic gain and citizens' fatality risk. To assist in the analysis of this trade-off, Schelling (1968) and Drèze (1962) introduced the concept of the value of a statistical life (VSL), which amounts to the value of the societal sacrifice for an incremental reduction in a fatality or hazard risk (Viscusi and Aldy 2010; Ashenfelter 2006). Despite estimating VSL in different political contexts, e.g. Ashenfelter and Greenstone (2004) in the US, Kim and Fishback (1999) in South Korea and Leon and Miguel (2017) in Sierra Leone, the literature has exclusively used this framework to elicit citizens' preferences.[1] However, how much, if at all, citizens' preferences impact policy-making depends upon a country's political institutions and how politically empowered citizens are. Indeed, in some political regimes, the elite's preferences could be more significant for determining policy choices than those of citizens (Acemoglu and Robinson 2012).

In order to highlight the difference in decision-making on fatality risks between policymakers and citizens, we estimate the monetary value placed by a dictator on the statistical life of his subjects. In a dictatorship, the entitlement to the preferred state of the world belongs to the dictator and his preferences determine policy choices. Since VSL is commonly defined as citizens' willingness to pay for a risk reduction, we, therefore, define the dictator's valuation in terms of willingness to accept (WTA) compensation for a reduction in citizens' fatality risk. That is, we envision a hypothetical bargaining process (with an imbalance in bargaining power) between the citizens and the dictator over cit-

[1] The only exception that we have uncovered is Rohlfs et al. (2016), who estimate the implied value of statistical life based on military decisions during WWII, but they assume that the military maximizes social welfare and equates marginal cost with marginal benefit.

izens' fatality risk.[2] Since policymakers and citizens may have conflicting preferences over certain types of risks, the policymakers' WTA and citizens' WTP could differ substantially. To make a potential gap in preferences most vivid, we examine policy-making in Joseph Stalin's dictatorship for a brutal policy of the Great Terror in 1937 - 1938 aimed at the elimination of a potential fifth column and increasing his chances of preserving political power in case of a war (Khlevnuk 2009, Harrison 2008).[3]

The Great Terror had a substantial random component that raised the fatality risk of Soviet citizens. The screening technologies of enemy identification of Stalin's secret police were far from perfect (Gregory et. al. 2011) and, in fact, the bulk of victims were statistical in nature (Gregory 2009).[4] The total range of Great Terror affected about 1,500,000 Soviet citizens, 700,000 of which were executed (Gregory 2009). We must point out, though, that statistical repression was not an exclusive feature of dictatorial regimes.[5] Democracies also have implemented statistical repression when facing regime insecurity as it has been done by Franklin D. Roosevelt who ordered the forced relocation and incarceration

[2]We could have used an alternative concept, the dictator's willingness to pay for a reduction in the fatality risk of citizens, inserting dictator in place of citizen. No matter how this valuation is defined, we stress that it is conceptually distinct from the standard concept of VSL. One can see this clearly through Thomas Schelling's cleverly titled, "The life you save may be your own." The VSL is derived from a citizen expressing this value in terms of a risk that the citizen faces. It is a measure of subjective valuation of *own* life. In contrast, the dictator's valuation is not such a construct. The dictator's valuation need not be the subjective valuation of own-life fatality risk since the risk may or may not be one that the dictator faces. Modeling this valuation as a bargaining process respects this distinction while still grounding the concept in the VSL literature.

[3]Fifth column refers to a group within a society that works to undermine the society from within. The term became popular after the Spanish Civil war, when the nationalist general Emilio Mola told in an interview in 1936 that four columns of his army would attack Madrid, and the fifth column of his supporters inside the city would undermine the republican government from within.

[4]We distinguish between statistical and identified victims. The former are victims who were selected by a probability law whereas the latter were evidentially identified.

[5]Statistical repression refers to actions that physically suppress individuals of society through statistical discrimination.

of over 60,000 US citizens of Japanese ancestry, targeted purely on the basis of population shares in a given location.

In order to isolate the component of statistical terror, we focus on the "national operations" of the Great Terror, providing a clear population target in which ethnicity alone determined a policy-driven increase in fatality risk. Due to population sizes and data availability, we restrict attention to the operations against ethnic Poles and Germans, whom the government considered as potential traitors in war time. More than 195,000 Soviet citizens were arrested, with two-thirds of these having been executed, under "national campaigns" against Poles and Germans in 1937 - 1938 (Petrov and Roginskii 1997; Okhotin and Roginskii 1999). On average, the fatality risk imposed by this policy of statistical terror was around twenty times higher than the contemporary US traffic fatality rate.[6]

The scope of the repressions had substantial regional variation in the distribution of terror victims and, in particular, there were a larger number of victims in the border areas. This was in line with the prevention of Stalin's feared scenario of a potential alliance between internal and external enemies, which posed a stronger threat in border regions (Harrison 2008). We assume that Stalin's objective in implementing the Great Terror was to enhance the chances of the survival of his regime in each region of the country, subject to the direct economic loss of human life. Therefore, we derive Stalin's decisions from the presumed balance between the loss of economic output and enhancement of regime survival. In this way, we can uncover Stalin's WTA for a reduction in fatality risk equivalent to the gain of one Soviet citizen's statistical life, which we

[6]This incremental risk is larger than what is typically studied in the VSL literature, e.g. Ashenfelter and Greenstone (2004).

call the value of statistical life in the dictatorship (VSLD).

A priori, we do not know the value placed by Stalin or whether VSLD differed dramatically from Soviet citizens' willingness to pay for a reduction in fatality risk. A glance at the raw numbers, however, suggests that the brutality of Stalin's regime was not without historical comparisons, and the intensity of statistical terror appears to not have reached the most egregious instances of these arbitrary mass killings by other dictators of the modern world. Dictators from Mao Zedong in China to Macias Nguema of Equatorial Guinea have implemented policies of arbitrary and statistical mass killings of similar magnitude in terms of population shares as Stalin did in order to further improve their regime's survival.[7] Idi Amin Dada of Uganda killed an estimated 100,000, many of which were arbitrary killings of civilians, out of a population of 11 million, roughly double the rate of the Great Terror overall.[8] Since the world's dictators likely have heterogeneous preferences, estimates of VSLD should vary and, in principle, one could replicate our method for other dictators, enabling a VSLD ranking of dictators.

Using a newly constructed data set on the regional distribution of victims of Stalin's "national operations" against Soviet Poles and Germans in 1937-38, we structurally estimate the parameters to recover Stalin's preferences. This allows us to specify the indifference curve that imbeds Stalin's revealed-preferred policy choice. We use the slope of this curve at meaningful points to determine Stalin's VSLD. We find that Stalin would have been willing to accept a little more than $\$43,000$ US 1990 for the reduction in citizens' fatality risk equivalent to

[7] Our comparisons purposefully exclude cases of overt genocide as well as targeted suppression of militarized anti-state groups.

[8] See Mass Atrocity Endings at https://sites.tufts.edu/atrocityendings/ . For this particular case, the website cites the International Commission of Jurists (1977).

one statistical life. This magnitude is stable across a wide variety of robustness checks. While this value is sizeable, it is far below what it could have been had Stalin cared more for the survival of his regime or would stop at nothing to ensure its survival. At the same time, the value is far from what it would be had he not been willing to put his citizens lives at risk to improve the likelihood of his regime's survival.

Comparing Stalin's valuation with the value of a statistical life under democracies (and assuming that Soviet citizens had similar preferences, on average, as other countries at similar levels of development), we notice substantial welfare gains from curtailing the policy of statistical terror. The magnitude of these welfare gains contributes to our understanding of economic development in non-democracies. If dictators systematically impose higher risks of fatality on its citizens than would have otherwise been imposed had citizens been empowered, then this policy distortion could explain the difference in outcomes in these regimes and the policy decisions and economic processes that generate them, such as the accumulation of human capital or the allocation of investments. Obviously, with only one observation of VSLD, we cannot establish i) whether the difference between VSLD and VSL is related to the risk environment of citizens and ii) that democracies have less of a difference, on average, between VSLD and VSL for a given set of policies. Thus, an important research agenda that our analysis makes possible would be to investigate whether both of these hypotheses hold.

Our analysis contributes to the debate on the nature of the Great Terror and Stalin's repressions. Historians have suggested a broad set of explanations of the phenomena: from an innocent dictator (Barnett 2006) to a dictator merely re-

sponding to the demand for terror from below (Getty and Naumov 1999; Goldman 2007). In route to obtaining our estimate of the value of a statistical life, we develop a view, which portrays Stalin as a strategic decision-maker, who relied on coercion to achieve his economic and political goals, taking into account the costs of his policies (Ilic 2006; Harrison 2008; Gregory 2009; Khlevnuk 2009; Harris 2013).

Estimating the value of a statistical life in dictatorships also has profound policy relevance. With such an estimate, countries can better influence and understand how dictators will respond to internationally imposed policies such as economic sanctions to discipline a political regime, provided that the dictators behave strategically and economic values enter their objective function. Dictators, just as with their democratic counterparts, can improve the design of domestic policies by using VSL and VSLD estimates. In Stalin's case, and specifically for the broader policies of the Great Terror, more effective and credible communication of Stalin's preferences to his subordinates may have better solved the principal-agent problems that were profoundly at work in other aspects of the Great Terror (Gregory 2009). There are no doubt other domestic and international policy decisions (transportation, environmental regulations, medical interventions) that would be assisted by the analysis of the value of statistical life of both citizens and policymakers under alternative political regimes. For example, Miller (2000) suggests that VSL could inform how Kuwait should have been compensated for the Gulf War.

The rest of the paper proceeds as follows. In section 2, we review the methodology of the value of a statistical life and discuss our approach for measuring the value of a statistical life under dictatorships. Section 3 discusses the historical

details of the Great Terror and introduces our data. In section 4, we formalize the trade-off between monetary gain and risk of fatality faced by Stalin in the maximization of his objective function. Section 5 is devoted to the estimation strategy. In section 6, we present the results and compare them with back-of-envelope estimates of VSL according to the preferences of Soviet citizens and state actors as well as estimates in the literature of the value of a statistical life in democratic countries. Section 7 presents the sensitivity analysis, including various robustness checks and a discussion of potential biases. Section 8 concludes.

2. Fatality Risk in a Dictatorship

We start with the standard definition of the value of a statistical life, which is expressed in monetary terms and calculated on the basis of a small reduction in a specified citizens' fatality risk, spread across a large, clearly defined population cluster.

Economists use both revealed and stated preference methods to estimate citizens' willingness to pay for a reduction in fatality risk.[9] Since we can't employ stated preference methods for a historical episode, we instead rely on reveled preference methods.

Several authors have suggested that citizens' WTP may change under alternative institutional arrangements (Kim and Fishback 1999; Ashenfelter 2006). Building on this logic, we argue that, in addition to citizen preferences, institutional differences with regard to the entitlement of the decision on the level of

[9] See Viscusi (2003) for an overview of these methods.

fatality risk that policy targets could impact VSL estimations.[10] Whoever possesses the entitlement determines whether willingness to pay or willingness to accept is the object of interest. If one assigns the entitlement to citizens, then we should estimate citizens' willingness to accept for an increase in fatality risk and, by extension, policymakers' willingness to pay for an increase in fatality risk. Typically, however, economists estimate citizens' willingness to pay for a reduction in fatality risk, implying the entitlement belongs to the policymakers, who must therefore compare this willingness to pay to their willingness to accept for a reduction in citizens' fatality risk.

In democratic settings, where citizens ultimately bear the cost of risk reduction policies through taxation, citizens defer their entitlement to risk reduction to their representatives on the basis of a social contract. A risk-reduction policy is usually adopted if it enhances social welfare. In effect, the policymakers' preferences are disciplined by citizens' preferences.

In contrast, in dictatorships with limited political representation for citizens, the entitlement over the preferred state of the world belongs to the dictator. If policy-making is driven by the dictator's preferences, any specified risk used to estimate VSL must be viewed in terms of the dictator's objective, which may differ or even contradict the citizens' objectives. There is no institutional guarantee that the dictator would base policies on any given set of agents' preferences (although he/she may certainly do so). Hence, to analyze a proposed policy of citizens' fatality risk reduction, the dictator's willingness to accept for a reduction in citizen's fatality risk, rather than citizens' WTP is the primary object of

[10]This point is not exactly new and has roots in an old debate on the role of economists in policy-making (Banzhaf 2009). The losers of the debate argued that policymakers had multiple objectives besides economic efficiency and economists should incorporate these objectives directly in the normative analysis of policies.

interest. To head off any confusion due to terminology, we point out that, in terms of willingness to pay, the dictator's VSL would be given in terms of an increase in fatality risk, more aptly called the value of a statistical death (i.e. in the standard use of VSL for citizen preferences, the WTA counterpart of WTP refers to an increase in fatality risk whereas for the WTP counterpart of WTA for the dictator refers to an increase in fatality risk). We therefore define the dictator's VSL (VSLD) as the monetary value that the dictator would be willing to accept for an incremental reduction in citizen risk of fatality, spread across a large population, equivalent to preventing the loss of one life in expectation.

Importantly, citizens' WTP for a reduction in fatality risk is still a useful construct in a dictatorship. It just does not tell us all the information we would like to know for policy-making. Investigating citizens' WTP in a dictatorship presents additional difficulties. Standard methods, such as contingent valuation or using wage/occupational risk differentials, may have less desirable properties when estimating VSL in dictatorships. For example, if preference heterogeneity is purposefully suppressed, then it will be more difficult to credibly elicit true preferences or, if decentralized decision-making is suppressed, it may be difficult to recover preferences from price or cost data.

Consider the hedonic price regressions that economists often use to estimate citizens' willingness to pay for a risk reduction. Policymakers use the estimates of citizens' preferences from these regressions by making an analogy between the type of risk the policy would impact and the on-the-job risk that workers face. Workers voluntarily choose one job with a certain level of fatality risk and wage over another job with a different level of fatality risk and wage and competitive markets accurately price opportunity cost of taking a different job.

In a democracy with well-developed labor markets, each of these assumptions are reasonable. In a dictatorship, all three assumptions are problematic. Hence, relying on the tangency condition to establish valuations based on unobserved preferences is questionable. Instead, we model the dictator's objective function explicitly and can therefore fully specify indifference curves and report more meaningful marginal valuations. Notice that we do not need to worry about the usual selection issue involved in estimating WTP as the dictator's problem exactly reveals his willingness to accept for saving a statistical life. We do however discuss several other potential sources of bias in section 7.

To illustrate these important differences, we introduce figures 1 and 2 for the type of risk imposed on Soviet citizens during the Great Terror. Statistical or random terror increased the likelihood that the regime would survive but also increased the fatality risk of the citizens.Opportunity costs were the only disciplining force that limited the dictator's policy of statistical terror. Figure 1 represents this unfamiliar fatal trade-off for policy-making in a dictatorship and figure 2 shows the same relationships in the familiar setting of policy-making in a democracy. For both figures, the y-axis is wealth in monetary terms, the x-axis represents citizens' fatality risk, bounded between zero and one; the blue-line represents the indifference curve of a representative citizen and the red-line represents the indifference curve of the policy-maker.

In terms of the citizens, the two figures are the same. Citizens' preferences are upward sloping at an increasing rate, that is more and more wealth is required to make the citizen indifferent as the fatality risk increases. The preferred point for citizens is at point A or zero fatality risk from statistical terror.

The two figures differ with respect to the policymaker. In figure 1, the dicta-

tor's indifference curve is downward sloping due to the dictator's desire to stay in power. The only institutional discipline the dictator faces is the opportunity cost of the loss of citizens' lives, their contribution to the gross domestic product, which in expectation is downward sloping at a constant rate. The dictator prefers policy point B, which is implemented despite the fact that citizens would be willing to compensate the dictator for a reduction in fatality risk. Note that, regardless of citizens' WTP, in this example, there will be a positive level of fatality risk due to the steepness of the dictator's preferences as the fatality risk declines. In figure 2, quite a different picture emerges due to the fact that the policymaker has similar preferences to citizens, perhaps because of humanitarian reasons or because they care about their constituents' well-being by institutional design. The policymakers also prefer point A, even if they have flatter preferences than the citizens have, since the budget constraint is downward sloping, i.e. it actually costs wealth to increase fatality risk for a policy of statistical terror.

3. Stalin's Policy of the Great Terror in 1937-1938

The dominant rationalization of Stalin's Great Terror policy, which cost at least seven hundred thousand lives of Soviet citizens, refers to Stalin's preparation for a new great war and his concerns on the emergence of the "fifth column" in the rear in the war time (Khlevnuk 2009, Harrison 2008). The capture of power by the Bolsheviks following Russian defeat in the First World War taught a profound lesson about the prospect for regime change in the aftermath of an unsuccessful war. Stalin particularly feared the potential coalition between internal and external enemies and attempted to prevent its emergence even at high

costs. Stalin's first deputy, Vyacheslav Molotov, in an interview in the 1970s, twenty years after Stalin's death, explicitly justified the Great Terror because it weeded out potential traitors in the USSR so that the feared alliance of foreign and domestic enemies had not come to fruition during the Second World War (Chuev 1991 P. 391).[11] "National operations" against ethnic minorities of neighboring mother-countries that posed a future war threat provides further grounds for such an interpretation.

"National operations" were an important component of the Great Terror policy.[12] They produced more than a third of all victims (247,000 out of about 700,000). Ethnic Germans and Poles formed the two largest groups among victims of "national operations". This was due to the relatively large size of these minority groups and the threats posed to the USSR from Germany and Poland in the late 1930s. Under Polish and German campaigns, 140,000 thousand and 55,000 Soviet citizens were arrested correspondingly. In addition to these two major minorities, national operations affected Soviet Romanians, Greeks, Latvians, Estonians, Lithuanians, Fins, Bulgarians, Iranians, Afghans, Koreans, Chinese, and Japanese. Execution rates, i.e. a ratio of executions to all arrests, were substantially higher for the "national operations" 73.66 percent on average (79.44 percent for the victims of the campaign against Poles and 76.17 percent for the German campaign) in contrast to the 43.3 percent execution rate during the Great Terror years and 14.3 percent average execution rate under Stalin (Petrov and Roginskii 1997; Okhotin and Roginskii 1999).[13]

[11] Archival documents demonstrate that Stalin himself believed that betrayals were the dominant reason of defeat of the Republicans in the Spanish Civil War happening at the same time. The Great Terror in the USSR went in parallel with attempts of the Spanish communists (directed from Moscow) to eliminate traitors among the Republicans in Spain (Khlevnuk 2009).

[12] See Appendix A for further historical details about the Great Terror.

[13] Those victims who were spared execution were sent into labor camps (the Gulag) where life and working conditions were tough. The mortality rate in the Gulag was between four and six

One could view the share of targeted ethical minorities in a region as a proxy for the level of the local internal threat observed by the dictator. Using the population census, we have access to the same information on potential disloyalty that the dictator had. This makes the "national operations" component of the Great Terror particularly attractive for the study of the dictator's preferences. We limit our analysis to the largest two minorities, Germans and Poles, because of data availability.

During "national operations", Soviet citizens of targeted ethnicities, and especially those with special ties to their "mother countries" were under a higher risk of arrest and being labeled spies. Particular ethnic groups whose loyalty was especially problematic in the eyes of the dictator were in danger first of all; e.g. in the case of Soviet Poles the secret police paid special attention to former prisoners of Soviet-Polish war, who remained in the USSR, to former Polish citizens, who fled into the USSR during the 1920s and 1930s, to former members of Polish social party, to leaders of Polish national movement in the districts with substantial Polish minority etc. In practice, implementation and screening technologies for true enemies were poor. Many loyal Soviet citizens became victims as a result of the statistical nature of the Great Terror. The Soviet government was well aware about that. Stalin believed that if at least five percent of suspects were correctly identified as true enemies that would be qualified as a success (Stalin's speech at the meeting of the High Military Council on June 2, 1937, cited in Khlevnuk 2010 Pp. 300-1). In other words, the Great Terror, including its "national campaigns" component, implied additional fatality risks to Soviet citizens.

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times higher than the mortality rate of the corresponding "free" population (Vishnevskij 2006 p. 434). The Gulag composed about two percent of the Soviet labor force and produced about the same share of GDP (Lazarev and Gregory 2003).

The Soviet archives clearly show that Stalin himself made the key decisions about the Great Terror (Gregory 2009, Khlevnuk 2010), and the terror policy, therefore, represented the dictator's preferences. Stalin initiated the policy in 1937 and terminated the campaign in late 1938. In particular, the center closely monitored the implementation of the "national operations" using the so called "album procedure". In each region, lists of arrested citizens and implied sentences were recorded in special albums, which had to be sent to Moscow for a final approval by the commission consisting of the All-Union Minister of Secret Police and the All-Union Public Prosecutor (Petrov and Roginskii 1997; Okhotin and Roginskii 1999).

The government planned and implemented mass repressions as a top secret operation. There was no mention of them either in official media or in the public sphere. The secret police had to search for, identify and punish potential enemies without any publicity. For that, the government heavily simplified the judicial procedure during the "national operations". Once the secret police arrested a victim, it had to produce a short profile of the victim and to suggest a sentence. Next, on the basis of these documents, a regional "dvojka", i.e. a commission consisting of two officials (*dvojka*) - a head of regional secret police and a regional public prosecutor, had to make a decision on the sentence, choosing between an execution and imprisonment in Soviet labor camps for 5 or 10 years. Decisions were taken in absence of the accused citizen and without the right to appeal. The only supervision was from Moscow officials who followed the implementation of "national operations" and had to make the final approval of arrests (via "album procedure"). The center weakened its control with an increase of scope of repressions. When a rising number of arrested citizens caused sub-

stantial delays in Moscow approvals in September 1938, i.e. two months before the termination of the Great Terror policy in November 1938, Stalin simplified the procedure further. Local secret police offices got more power in the repression decision [14]. Accordingly, regional variation in repressions during the last two months of the Great Terror might to a lesser extent reflect the original preferences of the dictator because of initiatives from below and the differences in repression capacities of local administrations of the secret police.[15]

We construct a novel dataset on regional variation in implementation of the Great Terror in 1937-1938, combining recent works by historians (Petrov and Roginskii 1997; Okhotin and Roginskii 1999) and the 1939 Population Census (Polyakov 1992).[16] Table 1 presents summary statistics of available data. There were about 2,700,000 people in an average Soviet region. Among them, there was a bit less than 2,000,000 that lived in the countryside and about 950,000 were illiterate, capturing the levels of urbanization and human capital in a region. The average region consumed 641 million kilowatt hours of electricity, which measures local economic development.[17] During the Great Terror years, in an average region, about 25,000 people were arrested because of political reasons, or about 0.9 percent of total population. About 1,000 of them were arrested as a part of the operation against Germans and about 2,200 as a part of the operation against Poles. Out of these arrests, about 750 Germans and 1,850 Poles were executed in an average region. The rest were sent to the Gulag. Both

[14] Special commissions of three persons (trojka), which in addition to dvojka members included regional party leader, were established in each region. They temporally got the right of the final approval of repression decisions instead of Moscow.

[15] E.g. during the last phase of "national operations", the share of titular nationals among victims was only about two-thirds (Petrov and Roginskii 1997; Okhotin and Roginskii 1999).

[16] A detailed history of Stalin's repressions is still a work in progress (Unge, Bordukov and Binner 2008). Many aspects of this policy remain unknown. In particular, the spatial distribution of victims of "national operations" is known only for Germans and Poles.

[17] Electricity output is from Naumenko (2019).

the number of arrests and executions of Poles and Germans varied substantially across regions.

On top of human losses, the policy of Great Terror was costly in other respects. First, operational costs of the terror campaign were 75 million rubles in 1937 and another 100 million in 1938, i.e. about 0.05 percent of 1937 GDP (Mozokhin 2011 pp.189-200)[18]. Second, the Great Terror was accompanied by economic difficulties and slowdown of the economy of the USSR (Davies 2006).

4. A Model of Dictator's Fatal Trade-off

Consider a country consisting of J regions, that includes both *border* and *interior* regions.[19] The population of the region j in J is denoted by N_j. The total population of the country is

$$N = \sum_{j=1}^{J} N_j.$$

The country is ruled by a dictator, D, who is driven by two factors: the country's domestic product and the likelihood of his survival under an internal threat posed by the presence of the potential enemies.[20] Thus, the dictator's objective function is denoted by $D(Y, S)$, where Y is output, and S is the likelihood of regime's survival in face of the threat posed by the possibility of a coalition between internal and foreign enemies. Obviously, the value of the objective function is increasing in both variables, the output and the probability of survival.

[18]The Secret Police asked for another 70 million to cover 1938 operation costs, but the result of this request is unknown (Mozokhin 2011 p. 200).

[19]The distinction between these two types of regions will be made later.

[20]We do not model the threat from actual enemies who are identifiable by the dictator. The dictator's secret police could identify and arrest enemies in both interior and border regions, but these identifiable enemies are not statistical in nature. For simplicity, we assume that screening abilities of the secret police are the same in each region, and do not model identifiable victims explicitly.

In order to balance a challenging model (no a priori knowledge of dictator' preferences towards risk) with its empirical tractability, we make a restrictive modeling choice and choose the widely-used Cobb-Douglas functional form:

$$D(Y, S) = Y^{\alpha} S^{1-\alpha},$$

where α is the parameter between 0 and 1, which indicates the dictator's view of tradeoff between the national product and the probability of staying in power. If α is close to zero, then the dictator is mostly preoccupied with his own survival while almost disregarding the value of total production. If, conversely, α is close to one, the dictator is focused on the production side without being the preoccupied with the survival threats.[21]

To comment of our choice of specification, we must mention that we follow the literature on the topic (e.g, Aldy and Viscusi 2007), where the VSL is usually considered as the marginal rate of substitution between wealth and the probability of survival. However, the difference between our specification and the standard approach, where the value of α is determined by the survival probability, lies in the fact that the derivation of the VSL depends on individuals's ability to perceive and estimate the value of risk reductions. The issue is complicated as it is, but more so in our setting when we have only an indirect knowledge of the dictator's preferences. Thus, we opted for a fixed value wealth-survival probability trade-off. It is obviously a tractable FOC and offers us a clear empirical path for our estimation purposes. Moreover, the importance of regional integrity suggests that we lose little when abstracting from scale effects and, since empirically we don't know the distribution of output/probability of sur-

[21] The choice of a CES functional form would require estimating an additional parameter and further complicate the analysis without a clear justification for doing so.

vival within regions, we must in any case represent preferences in terms of the regional aggregates.

To enhance the value of his objective function, the dictator may implement a policy tool of the elimination of potential internal enemies. We assume that the population of each region j is divided in two groups, loyal citizens and potential enemies, where the number of the latter is denoted by M_j.The dictator chooses $\tau_j \in [0, M_j]$, which corresponds to the target level of his elimination policy in region j. It would be useful to point out that the group of potential enemies, in our case ethnic minorities, faces a risk of fatality which is stochastically related to the dictator's policy. This level is achieved by imposing a fatality risk of $\frac{\tau_j}{M_j}$ on each of the M_j potential internal enemies in the region.

Let us examine the impact of such a policy both on production and the survival probability. Our analysis will address the dictator's policy in all regions separately.

Production

We assume that the output Y_j is produced by the means of a unit linear production function that utilizes the labor supply in each region.

$$Y_j \equiv L_j.$$

Before the realization of the statistical terror policy, the population of each region determines the supply of labour

$$L_j^0 = N_j.$$

The implementation of statistical terror reduces the supply of labor in the following way:

$$L_j(\tau_j) = N_j - \tau_j.$$

Survival probability

Let us introduce the value of the probability of successful internal revolt supported by neighboring foreign countries, $R_j(\tau_j, M_j, N_j, \theta_j)$, where θ_j is the strength of external threat faced by region j. It is naturally to assume that this function is increasing is decreasing in the level of terror,τ_j, and the total population N_j, and is increasing in the number of internal enemies, M_j and the strength of the internal threat. In our setting we divide all these four variables into two parts, external and internal factors, and, for simplicity, assume that the probability of successful revolt is determined by the product of the value of the external threat and the fraction of the internal enemies after the the implementation of the terror policy in the entire population of the region.

Then the status quo likelihood of successful revolt is :

$$R_j^0 = \theta_j \frac{M_j}{N_j},$$

where $\theta_j \geq 0$ is the strength of the external threat in region j. However, the dictator can alter the status quo success rate of revolt by invoking statistical terror. After the implementation of the terror policy τ_j, this probability becomes

$$R_j(\tau_j, M_j, N_j, \theta_j) = \theta_j \frac{M_j - \tau_j}{N_j}.$$

The perceived threat is more acute in the border region because of potential

coalition between neighboring foreign countries and internal enemies. To take into account this observation, we set the value of θ_j to be the same and equal to $\theta > 0$ for all border regions, and to zero for all interior regions.[22] Thus, the probability of revolt in internal regions becomes zero, whereas in the border regions it turns into

$$R_j(\tau_j, M_j, N_j, \theta_j) = \theta \frac{M_j - \tau_j}{N_j}.$$

Note that the status quo probability of survival is given by

$$S_j^0 = 1 - \theta_j \frac{M_j}{N_j}.$$

After invoking the terror policy τ_j, this expression becomes:

$$S_j(\tau_j, M_j, N_j, \theta_j) = 1 - \theta \frac{M_j - \tau_j}{N_j}.$$

for border region, while being equal to one for interior ones. That is, for interior regions, the survival is guaranteed. Note that for border regions the value of S_j under the total terror ($\tau_j = M_j$) is also equal to one. The value of S_j in absence of terror ($\tau_j = 0$) is strictly greater than zero.

Let us now turn to the examination of the dictator's objective function.

Objective function

In absence of statistical terror policy, expected dictator's utility in a region j is

$$D_j^0 = (L_j^0)^\alpha (1 - R_j^0)^{1-\alpha}.$$

[22] The main point here is to distinguish between interior and border regions. The specific assumption on the values of θ_j can be easily weakened.

Then, we derive the level of the objective function of $D_j(\tau_j, M_j, N_j, \theta_j)$ in region j:

$$D_j(\tau_j, M_j, N_j, \theta_j) = (N_j - \tau_j)^{\alpha} \left(1 - \theta_j \frac{M_j - \tau_j}{N_j}\right)^{1-\alpha}.$$

First note that for interior regions $\tau_j = 0$ and there is no terror policy.

For border regions, after taking logarithms, we obtain the first order conditions with respect to τ in the following form:

$$-\frac{\alpha}{N_j - \tau_j} + \frac{(1-\alpha)\theta}{N_j - \theta M_j + \theta \tau_j} = 0. \tag{1}$$

Rearranging terms yields:

$$\tau_j^* = \frac{(1-\alpha)\theta - \alpha}{\theta} N_j + \alpha M_j = (1 - \frac{1+\theta}{\theta}\alpha) N_j + \alpha M_j. \tag{2}$$

Let us make two observations:

The optimally chosen τ_j^* is decreasing in α. This relationship is intuitive. As α increases, stability contributes less to the dictator's objective function thus reducing his optimal terror level. To show that take derivatives of (2) to get $\frac{\partial \tau_j^*}{\partial \alpha} = -\frac{N_j}{\theta} - (N_j - M_j)$. Since $\theta > 0$ and $N_j \geq M_j$ for any region, the whole expression is always negative.

The optimally chosen τ_j^* is increasing in θ. This result illustrates the pernicious incentives of the dictator. An increase in the strength of the external threat increases the incentives to engage in statistical terror. Simple algebra shows that $\frac{\partial \tau_j^*}{\partial \theta} = \frac{\alpha N_j}{\theta^2} > 0$.

5. Estimating VSLD

In this section, we describe how we obtain VSLD, using a revealed preference approach. The first step is to recover the dictator's preferences implied by the model and the data. Then, once we have estimates of these structural parameters, we calculate the marginal rate of substitution (MRS) between wealth and regime survival. Finally, we compute the VSLD by converting this value to the relevant units.

5.1. Estimation of the structural parameters

We assume a data generating process that results in the observable number of victims of the national campaigns in a region, K_j, being a random variable that depends upon, but is not fully determined by, the level of statistical terror chosen by the dictator. Empirically, it would be difficult to claim that $K_j = \tau_j$. Instead, K_j may capture identifiable victims, those who the secret police would have implicated as committing crimes independent of the statistical terror, and idiosyncratic deviations from the optimal level of statistical terror. We thus represent the observed number of victims in a region as:

$$K_j = \tau_j + \nu_j + \epsilon_j$$

where τ_j is defined above as the optimal number of victims due to statistical terror, ν_j captures the number of non-statistical, identifiable victims and ϵ_j represents the deviation from the optimum due to unknown factors.

Since all of the above components are unobservable to the econometrician, we need to make several assumptions. For τ, we assume it is determined opti-

mally as a function of $(B_j, M_j, N_j, \alpha, \theta)$, where α is a parameter to be estimated and θ could be estimated or calibrated.

We think of ν as the number of victims that would have occurred during the Great Terror if there had not been the *statistical* elimination of potential internal enemies due to the linkage between internal and external threats in the border regions. As such, the interior regions can serve as a counterfactual on how many identified victims there would be in the absence of a strong linkage between internal and external threats. Here, the assumption is that conditional on the level of statistical terror, there is the same rate of political enemies per capita. This means that ethnic Germans and Poles are no more likely to be political enemies than ethnic Russians or other ethnic groups in the Soviet Union in the absence of a linkage of external and internal threats.

Without loss of generality, we can rewrite ν as the a linear projection on M, $\nu_j = \eta M_j + u_j$, where η is a parameter that we can estimate and u_j is by construction orthogonal to M_j and has zero mean. We need to make the assumption that u_j is independent of B_j (and ϵ_j). .

As is standard, we treat the unobservable, idiosyncratic residual term, ϵ, as having a zero mean and being conditionally independent. In particular, this implies that if we hold ν constant, in expectation, K_j, will equal the optimal level of statistical terror.

In all, we have three parameters to estimate or calibrate, η, α and θ.

We rewrite the FOC in equation (1) in terms of observables and an idiosyncratic error component. Taking expectations, we derive the following:

$$E[K_j - (\eta M_j + \frac{(1-\alpha)\theta - \alpha}{\theta} N_j * B_j + \alpha M_j * B_j)] = 0 \tag{3}$$

We then put in per capita terms where k and m are the per capita counterparts of K and M:

$$E[k_j - (\eta m_j + \frac{(1-\alpha)\theta - \alpha}{\theta} B_j + \alpha B_j * m_j)] = 0 \tag{4}$$

We estimate α using (generalized) method of moments and the FOC as a moment restriction. In our main analysis, we employ this sole moment restriction.

Given our identification assumption about border, we have in effect two moment conditions, one for border regions and one for non-border.

$$E[K_j - \eta M_j] = 0 \forall \text{ j with } B_j = 0$$

$$E[K_j - (\eta M_j + \frac{(1-\alpha)\theta - \alpha}{\theta} N_j + \alpha M_j)] = 0 \forall \text{ j with } B_j = 1$$

We first estimate η using the non-border regions. Then, we estimate the moment given by the FOC for border and nonborder regions, plugging in our estimate of η. To estimate both α and θ, our preferred estimation strategy, we use the FOC along with our exogenous variables as instruments. To be precise, we interact each of the following variables, the border indicator, the number of foreigners per capita and their interaction, with the FOC to generate additional moment restrictions and estimate using generalized method of moments. Finally, we plug in our estimates into the equation for the VSLD, which we describe below. We obtain confidence intervals for VSLD and other parameters by bootstrapping the whole procedure, with stratified re-sampling for border and non-border.

We point out that the FOC has a familiar structure. While our parameters and model place a number of additional restrictions, the reduced form equation (5) mirrors a difference-in-differences estimation of a treatment effect. In our case, the treatment variable is an interaction of a dummy for a border region, i.e. a proxy for the external threat, and the number of potential internal enemies per capita:

$$k_j = \beta_1 * B_j + \beta_2 * m_j + \beta_3 B_j * m_j + e_j. \tag{5}$$

Our parameters are identified by the following relationships:

$$\alpha = \beta_3,$$

$$\theta = \frac{\beta_3}{1 - \beta_1 - \beta_3}$$

where we should then test whether the following restrictions hold: $1 > \beta_3 > 0$ and $\beta_1 + \beta_3 \leq 1$.

We also estimate α by calibrating the parameter θ and using the FOC as the single moment restriction (or two moment conditions if counting FOCs for border and nonborder as separate conditions). Assuming that the probabilities of revolt in different regions are independent, the probability that the dictator will lose power over at least one region is $1 - \prod_{i=1}^{J}(1 - B_j\theta\frac{M_j}{N_j})$. While the feasible θ is from zero to $\frac{N_j}{M_j}$, in practice, higher θ pushes regions with higher enemies per capita to the boundary much more quickly and a θ of about 2 would already imply a greater than 50% chance that the dictator would lose at least one region. Since all border regions are located in the interior, we focus on smaller values

and explore higher values in the robustness section. We take two benchmark cases: i) $\theta = .065$, which corresponds to a 2.5% chance that the dictator would lose at least one region and ii) $\theta = .125$, which corresponds to a 5% chance that the dictator would lose at least one region. We select these benchmarks in order to follow the official Soviet military doctrine that stated that the Red Army would defeat the enemy on foreign territory with an objective of no loss of Soviet regions (Red Army Field Manual, 1939).

5.2. Estimating the VSLD

After estimating α and using the objective function of the dictator, we can derive the VSLD, which is a counterfactual value due to the nature of the dictatorship. In the absence of market prices and voluntary action, the precise point of tangency between the dictator's budget constraint and his indifference curve has limited meaning. In the border regions, for all α, $MRS^* = \frac{N_j}{\theta}$ at the optimum due to the implied technological terms of trade, which are constant within each region. This means that all α-types are observationally equivalent at this tangency. Because of the endogeneity of citizen fatality risk in the dictator case, we need structural assumptions (i.e. Stalin's preferences) about how this risk is determined to unpack the VSLD estimate.

Instead, we focus on the dictator's WTA using the following thought experiment. Holding the dictator's utility constant at the optimum, we can ask what value does the MRS take when the policy of statistical terror approaches zero victims. This point is on the steepest part of the indifference curve within the range of regime survival that the policy can affect. Thus, the slope at this point yields the maximum value that the dictator would need to be compensated for

saving one statistical life.

As the first step, we obtain the indifference curve that intersects the optimum. This utility level is $u_j^* \equiv L_j^{*\alpha} S_j^{*1-\alpha}$, where L^* and S^* are the values of L and S at the optimum. Holding the dictator's utility level constant, for any L, S pair, the marginal rate of substitution of output for regime survival is:

$$\frac{(1-\alpha)}{\alpha}\frac{L}{S}$$

While staying on the indifference curve that intersects the optimum, we compute MRS at the point where S equals the baseline risk. This yields

$$MRS = \frac{1-\alpha}{\alpha} L_j^* (S_j^*)^{\frac{1-\alpha}{\alpha}} (1 - \frac{\theta M_j}{N_j})^{-\frac{1}{\alpha}}.$$

We plug in $\hat{\theta}$ and $\hat{\alpha}$ for θ and α, respectively.

Then, at the second step, we convert units of regime survival to units of citizen fatality risk, since the obtained value of MRS is with respect to regime survival. That is, moving citizens' fatality risk from zero to one does not move the probability of survival of the regime in a border region from zero to one. Thus, we need to multiply the MRS by $(1 - (1 - \frac{\theta M_j}{N_j})) = \frac{\theta M_j}{N_j}$, which is the length of the interval as we move from a fatality risk for citizens of one to zero fatality risk. Since M citizens facing a reduction in fatality risk of $\frac{1}{M}$ would produce a gain of one statistical life, we divide by M. In this way, we get the value that one would have to compensate the dictator for a reduction in fatality risk equivalent to saving one statistical life.

Finally, we convert this value from units of output to units of monetary cost. This final step consists of multiplying by g, the monetary value of per capita

output.

This procedure then results in:

$$VSLD \equiv g(\frac{(1-\alpha)(1+\theta(1-\frac{M}{N}))}{1-\theta\frac{M}{N}})^{\frac{1}{\alpha}}.$$

If the policymakers' preferences perfectly reflect the median voter (pure democracy), there would be no weight placed on regime survival, $\alpha = 1$, and VSLD would be equal to zero, technically, it would be less than or equal to zero. Recall that, for this particular risk, the dictator and the citizen have opposing preferences. A more democratic dictator, who valued regime survival less, would be willing to accept a lower amount to reduce citizens' fatality risk from statistical terror, which is intuitive. As α moves away from one toward zero, VSLD increases and does so quite rapidly as α approaches zero. If there were Coasean bargaining between the dictator and the citizens or the broader international community, one obvious result is that the more brutal the dictator is, represented as a lower α, the more compensation is needed to achieve a reduction in citizen fatality risk.

6. Discussion of results

We start by presenting the results of the reduced-form regressions in Table 5. In Column (1), we present the sparsest specification that still allows us to recover the structural parameters of interest. The key effect of interest is the coefficient on the interaction term between Germans and Poles per capita and the border region dummy. It is positive and statistically significant and it's magnitude is large, implying an increase in the homicide rate represented in victims

per 100,000 citizens of over 300 from one standard deviation increase in Germans and Poles per capita (0.08). In Columns (2)-(5), we control for various factors, including electricity consumption per capita, a measure of economic development of a region, for which we have data and which could influence the efficiency or intensity of statistical terror and their interactions with the border dummy. The coefficient of interest remains statistically significant and its magnitude is relatively stable. In Tables 3 and 4, to which we now turn, we discuss what these estimates imply for the structural parameters of interest.

Table 3 reports the estimates of the parameter α, which governs the MRS, for the reduced-form estimates in column 1, the GMM estimates in column 2 and the MM estimates using calibrated levels of the severity of the external threat in columns 3 and 4. In our preferred estimation, the estimate for α is 0.044 and the estimate for θ is 0.046. Both are precisely estimated and the bootstrapped confidence intervals are narrow. The estimate for θ is lower than, but close to, our ex-ante reasonable choice of θ based on our reading of historical evidence on Stalin's desire not to lose any region in case of a war. Across the board, we see low values of α, not too far from zero, with a range of 0.041 to 0.111. All else equal, a higher value of α implies a lower MRS, suggesting that Stalin placed a great weight on survival. However, one must interpret α both in its distance from zero and its distance from one. The estimated α's are all statistically different than zero and one. Any movement away from one suggests that Stalin cared about the survival of his particular regime more than what the standard methodology implies for policymakers in democratic settings and any movement away from zero suggests that Stalin did not blindly aim for regime survival but also cared about the economic output of his empire.

These estimates of α and θ translate into estimates of the VSLD and Table 4 reports the implied values. We report the average VSLD across the regions. To get a sense of how precisely estimated this mean is, we report 95% confidence intervals, which we obtain using bootstrapping methods. We find a value of $\$43,151$ US 1990 in our preferred specification. In the estimations using a single moment condition derived from the FOC and a calibrated θ, increasing θ does not dramatically change the VSLD, mostly due to the fact that the estimate for α must increase to fit the data and this offsets the increase in the VSLD due to an increase in the external threat.

If we abstract from the actual policy outcome, we can explore how sensitive VSLD is to changes in parameters. Figure 3 shows how the value of VSLD changes for the average region if Stalin had had somewhat different preferences, holding θ fixed. We report these values for two different levels of θ, representing alternative environments that Stalin may have faced. For θ values, we chose the estimated level of θ according to our preferred estimation (0.046) and the highest value of θ that we use when making calibrations (0.125). For convenience, we have drawn a dotted vertical line at $\alpha = 0.044$, representing Stalin's type in our preferred estimation. The points of intersection of this dotted line and the curves give Stalin's VSLD under these different strengths of the external threat (for $\theta = 0.046$, the intersection point gives our preferred estimate of Stalin's VSLD). For $\theta = 0.046$, an α-type of 0.02 would result in a VSLD of approximately $\$160,000$, where as an α-type of 0.1 would result in a value of little less than $\$24000$, revealing that Stalin had an intermediate value, if our estimate of θ is accurate. This intermediate value is deceptive, though, because moving to the right on the x-axis, we can find dictators of "nearby" types, who would

not have initiated any positive level of repression when faced with the same regional distribution of population groups. When $\theta = 0.125$, VSLD is higher for any given type, and increasingly so as α approaches zero. If this were the actual level of θ in 1937-1938 in the USSR, a dictator of Stalin's type (with alpha 0.044) would have had a VSLD of roughly $\$226000$ and, in such a case, we would have observed, in expectation, all of the ethnic Germans and Poles being repressed during the national campaigns.

What can we say about the value of Stalin's VSLD? The first and most glaring point is that this value is quite large compared to $ 0 US 1990 (or even negative values) that policymakers in a pure democracy would accept to reduce the number of statistical victims in a policy of statistical terror. In a counterfactual exercise, the average border region would have had to compensate Stalin roughly about $\$300$ million US 1990 to prevent the policy of statistical terror in the region. Second, $43,151 is not terribly high, roughly equivalent to the net present value of the per capita national income stream, if one had the prior that Stalin would stop at nothing to maintain his grip on power.

In the model, Stalin would have been willing to accept this amount in exchange for one less statistical victim of terror. This is indeed an arresting result demonstrating the importance of institutions to discipline political decisions when they deviate from citizens' preferences. Even though Stalin behaved strategically, and some would say rationally (see a discussion on that Barnet (2006), Harrison (2006), Wheatcroft (2006)), his dictatorship as a political institution failed to prevent the implementation of policies that had dire effects from both a humanitarian and a social welfare point of view.

Our estimates are also in line with an external estimate of how Stalin's judges

valued the life of Soviet citizens. Heinzen (2016) provides archival examples of revealed bribes which Soviet citizens paid to officials to escape punishment. These historical anecdotes imply that one had to pay between 3000 and 40000 rubles to annul long prison sentences which might be viewed as the closest to bribes for saving ones life. [23] To recalculate these figures in 1990 US dollars, we use the exchange rate of 1.64 that yields a range between $\$4,921$ and $\$65,616$ US 1990 dollars.[24] Of course, the use of bribes is problematic for a number of reasons. First, we need to assume that the judges' interests are based on a calculation as to the value that Stalin places on the death of the citizen or pool of potential offenders. This assumption seems reasonable as Stalin effectively communicated his vision on repressions through the ranks (Gregory 2009). Second, bribe payers are identified victims. However, if judges are willing to reveal that sentences can be bought and each citizen had an ex-ante probability of committing an offense while doing socially beneficial activities, then the possibility of bribes would reduce citizen's fatality risk. Finally, since we only observe the bribes that citizens are willing or able to pay, we do not observe the full distribution of willingness to accept valuations.

In a more modern perspective, consider the cost of the Iraqi War aimed to prevent future atrocities of the Hussein regime. In 1989, the GDP per capita of Iraq was of a similar magnitude as the Soviet Union in the 1930s. If Saddam Hussein had a similar VSLD as Stalin, then, for the total cost of the war (about 1.7 trillion 2011 US dollars, NATO/US could have paid the Iraqi dictator to re-

[23] Unfortunately, there are no examples of a judge took a bribe in a death penalty case in the known archival documents. In private correspondence, Professor Heinzen argues that it "would have been extremely risky, and likely would have subject the judge to the death penalty himself". We thank Professor Heinzen for these details.

[24] To get the exchange rate, we divide Maddison's estimate of Soviet GDP per capita in 1940 in 1990 US dollars and Harrison's estimate of Soviet GDP per capita in the same year in 1937 roubles (Harrison 1996).

duce citizens' fatality risk on the order of nearly 40 million statistical lives, 33% more than the whole population of Iraq). Of course, this thought experiment works better as a basis to understand the magnitude of the Stalin's VSLD than as a policy recommendation for handling future dictators, since there are strategic issues and other costs involved in such an offer.

6.1. Comparison of results to estimates of VSL in democracies

How does Stalin's VSLD compare to estimates of VSL in democracies? Before answering this question, two disclaimers are in order.

First, the estimated VSLs from democracies are in terms of citizens' willingness to pay for a reduction in fatality risk, while the Stalin's VSLD is in terms of willingness to accept for a *reduction* in citizens' fatality risk. It is important to keep in mind that Stalin's utility, based on the preferences that we impose, is increasing in both wealth and citizen's fatality risk. However, the comparison between citizens' VSL and Stalin's VSLD still has sense due to the fact that, in a democracy, policymakers' willingness to accept for a reduction in citizens' fatality risk is disciplined by citizens' willingness to pay. How disciplined the policymakers' WTA is provides the analyst how "democratic" the political institutions that can be measured across different types of de jure institutions are.

Second, we would like to underline that we are not comparing the value of life under different political regimes. The value of life and the value of statistical life are conceptually distinct. In the colloquial sense, the value of life is, of course, subjective and need not be measurable. As such, we do not consider the value of life in an abstract sense and are certainly not suggesting that the sanctity of life depends upon the political regime. In contrast, the value of a

statistical life is a meaningful comparison precisely because it could sensibly vary by political regime, both in terms of policy-makers' WTA and citizens' WTP as well as the types of fatality risks that policies affect.

Ashenfelter and Greenstone (2004) give a conservative estimate of 1.5 million USD (1997) for modern US. This is roughly 50 times GDP per capita. Closer to the time of Great Terror, Costa and Kahn (2004) provide a range for the VSL estimate of 713,000 - 996,000 USD (1990) in the US in 1940. According to Maddison daaset, the GDP per capita in the US was 7010 USD (1990) in 1940 or about 3.25 times higher than Soviet GDP per capita of 2156 USD (1990) in 1937. Performing a benefits-transfer calculation using an income elasticity of 1.5 gives a range for the VSL of $146,000 to $204,000 USD (1990).[25]

If we look to modern developing countries operating in a democratic mode, Pakistan is probably the closest to Stalin's Soviet Union in terms of GDP per capita at $2240 USD (1990) in 2007.[26] However, we choose to focus on India with a GDP per capita of $ 2817 in 2007 because there are more VSL estimates available and because India is also the hypothetical comparison group chosen by Allen (2003) in his influential analysis of the comparative development of the Soviet Union. For India, Bhattacharya et al. (2007) using a stated preference analysis find a VSL of $150,000 USD (1990). Using wage differentials due to occupational risk, Madheswaran (2007) finds $150,000-$300,000 USD (1990) estimate of VSL.[27]

No matter how we approach the comparison group, the estimates of the VSL in democracies are significantly higher in magnitude than the VSLD estimates

[25]We use 1.5 because Costa and Kahn find such an income elasticity. Leon and Miguel (2017) find 1.77 in modern day Sierra Leone. An elasticity of 1.7 would give a range of $129,000 to $180,000 USD (1990). An elasticity of 1 would give the range, $219,000-$306,000 USD (1990).

[26]Rafiq and Shah (2010) find an estimate of $122,047 to $313,411 of VSL in Pakistan.

[27]Shanmugams (2001) finds a higher range of $760,000 to $1,020,600 USD (1990).

we find for Stalin's dictatorship. Since dictatorships give less political empowerment to its citizens, we can not conclude that some type of Coasean bargaining would have occurred between citizens' representatives and the dictator in the Soviet Union. But it seems reasonable to speculate that quite a few would be willing to pay to avoid this fatality risk (and some did using bribes to judges as discussed above).

One point that immediately follows from here is that in a democracy, even if some policymaker were as brutal as Stalin and had VSLD$>>0$, as long as citizens were empowered with some political voice or control, no statistical terror would take place. More to the point, we can ask the following question: how much weight would a democracy with a similar level of GDP per capita have to place on Stalin's preferences in order to implement a policy of statistical terror with a positive level of expected victims? Taking our estimate of VSLD and giving this valuation a weight of ω, along with the citizens' valuation as $150,000USD(1990)$, and giving citizens a weight of $1-\omega$, the ω' that would yield a positive level of victims would be $\omega' \geq 0.776$ ($\omega' = 150000/(150000+43180)$). This number assumes that the policy of statistical terror has no costs to implement. Holding the dictator's valuation constant, introducing costs would raise the required ω. The important point from this exercise, however, is that if a democracy had elected a policymaker with similar preferences, it would be highly unlikely (although possible) that statistical terror would occur. In a Rawlsian democracy with 45 million voters (approximate number of votes in the 1936 US presidential election), where every citizen is given equal weight, for example, the society would have to weight the policymaker's valuation 160 million times (0.78/(0.22/45,000,000)) more than the weight given to the typical

citizen.

7. Sensitivity analysis

7.1. Robustness checks

In this subsection, we perform our analysis using alternative measures of victims of the Great Terror. Our preferred measure counts victims that were arrested and sent to the Gulag labor camps as well as those that were arrested and executed. While nearly three-quarters of those arrested under the German and Polish national campaigns were executed, it is important to verify that our estimates are robust to just focusing on executed victims. Table 5 shows that our estimates hardly change when only executed victims are used.

A second complication is the fact that the terror policy changed during the period under study. In particular, as we discussed in the historical section, the album procedure may more accurately reflect the dictator's preferences for statistical terror than the procedure that had been put in operation during the last two months of the Great Terror. Table 5 reports the estimates of the dictator's VSL using only those victims of terror based on the album procedure, i.e excluding those who were arrested during October and November of 1938. We see that the values are roughly the same although somewhat lower when all victims are used.

7.2. Discussion of biases

First, we discuss some distortions to Stalin's opportunity cost of increasing citizens' fatality risk. The most important distortion for our purposes was the Gu-

lag since the fact that Stalin was able to repress victims at lower economic cost would make our estimates of α downward biased.[28] Another distortion could be due to transaction costs involved in the policy of terror. This would instead result in an underestimate of VSLD. In addition, while Stalin designed the terror policy to be as secret as possible, we can not rule out that some information about the policy leaked to the general public. Social disorder due to the fear of terror and the corresponding economic decline would impose an additional economic burden when increasing the fatality risk. Hence, our estimation of α would be biased upwards and the estimate of VSLD should be higher.

In order to assess the magnitude of these biases, we introduce a tax, t, on economic output for each victim of terror. We then derive the optimal policy and reestimate VSLD under the more general objective function of $D(\tau_j; t)$:

$$D(\tau; t) = (N_j - (1+t)\tau_j)^{\alpha} \left(1 - B_j \frac{\theta(M_j - \tau_j)}{N_j}\right)^{1-\alpha},$$

for various values of t.

This procedure then results in:

$$VSLD(t) \equiv g(1-\alpha)^{\frac{1}{\alpha}}(1 + t + \frac{\theta}{(1-\theta\frac{M}{N})})(1 + \frac{\theta}{(1+t)(1-\theta\frac{M}{N})})^{\frac{1-\alpha}{\alpha}}$$

By increasing this tax (subsidy), we can arbitrarily approach $\alpha = 0(1)$, so it is important to get some sensible magnitudes. To correct for the bias introduced by production in the Gulag, we use a subsidy of about 7% on each terror victim. We obtain this figure using the following back-of-the-envelope calculations. Standard sentences for those who were sent to labor camps, avoiding

[28] Indeed, one of the motivation for the establishment of the Gulag Archipelago in late 1929 - 1930 was to extract labor service of those who were arrested anyway (Khlevnuk 2004)

execution, during the Great Terror were 5, 8 or 10 years (Bezborodov et al. 2004). The mortality rate in the GULAG was 5.3% in 1937-1941, about 25% in 1942 and 21.2% in 1943 (Bezborodov et al. 2004). An average victim of the Great Terror who was sentenced to 8 years died by the end of his sentence with a probability of 68% (assuming the mortality rates are independent over the years). Productivity of GULAG labor was roughly half that of free labor (Ivanova 2000).[29] From that, we get (0.26*0.5*[0.68*[.289086 (5.78/20)] + .32])=0.067. Column 1 of Table 6 demonstrates that the subsidy would result in 7% increase in the estimate of α, and the VSLD estimate decreases to $\$40164$. Thus, to the extent that this bias is present, it does not qualitatively change our findings.

For transaction costs, we take a conservative approach. If we were to fund the whole budget of the Great Terror, estimated to be about 0.05 percent of GDP (see the historical section above), with a per victim tax, then, on average, this would equate to a 34% surcharge. Column 2 of Table 6 demonstrates that the tax would result in 24% decrease in the estimate of α, and the VSLD estimate increases to $\$57907$.

For the terror externality, we calibrate the tax based on Davies' arguments that the Great Terror led to economic difficulties; we arbitrarily choose a two percent decrease in output as an upper bound of decline.[30] This would imply a tax of 1257% if we were to attribute a similar impact of the Great Terror produc-

[29] Ivanova's estimate is very rough; but, it is the only estimate in the literature to the best of our knowledge.

[30] According to Maddison dataset, there were 8.3 percent increase in GDP per capita in 1937 and 0.3 percent decline in 1938. The average growth between 1928 and 1940 was 3.9 percentage points per year. Davies (2006) provides qualitative arguments and disaggregated figures on output of particular industries in support of his conjecture. His examples are from the formerly secret Soviet archives. Manning (1993), who wrote in the pre-archive era, argued that the Great terror was a response rather than a cause of economic difficulties. In an earlier work, Katz (1975) undertook a number of econometric exercises (based on official data), results of which are in line with Davies' rather than Manning's point of view.

tion externality to the particular component of the national campaigns against Soviet Poles and Germans, resulting in a very conservative upper bound. Column 3 of Table 6 shows that the bias induced by the terror externality could alter the qualitative nature of our results. Such a sizeable tax would reduce our estimate of α by 92% and increase the VSLD estimate to $\$593251$, which would put it above the range of WTP estimates in democratic countries of similar GDP p.c. If Stalin was aware of such a large terror externality, then Coasean bargaining would not have stopped the Great Terror from happening under his revealed preferences. Most likely, however, the economic downturn was an unexpected outcome for the dictator; Stalin put a lot of effort to keep the Great Terror secret exactly with the purpose to avoid potential negative externalities.

Second, the dictator's capacity to access the economy and social system to his advantage may be more limited than we assume. If this capacity is assumed to be similar across the population, then this won't affect our estimates of α, but it will lower our estimate of VSLD.

Third, one could question whether Stalin's preferences over the fatal trade-off differed for Soviet Germans and Poles than for ethnic Russians. If Stalin placed additional utility on having ethnic Russians alive, then we would underestimate α and overestimate VSLD for statistical terror once it applied to the population in general.[31] However, we are not so concerned about this issue. First, the motivation for the national policies of statistical terror would have excluded ethnic Russians. In addition, Soviet Germans, Soviet Poles and citizens subject to other national campaigns were all Soviet citizens and, on a commu-

[31] We can not repeat our exercise considering all victims in each region rather than German and Polish victims only because we do not have information on the number of potential enemies in a region observed by the dictator before the Great Terror; distinguishing between internal and external regions is also less pronounced once we are talking about all Soviet citizens and not only about minorities.

nist ideological basis, were indistinguishable from ethnic Russians. Moreover, even if there were such a distinction, heterogeneity in VSLD by ethnicity is an interesting feature of Stalin's dictatorship on its own and Soviet Germans and Poles were important minority groups.

8. Conclusion

We extend the concept of the value of a statistical life to incorporate the preferences of policymakers in a dictatorship. The dictator's VSLD under Stalin was about 43,200 1990 USD or about one-third of the VSL based on citizens' preferences in a democracy with comparable level of income per capita.

Our results contribute to understanding Stalin's behavior and his strategic response to the fifth column. Our approach relies on viewing Stalin as a rational dictator but, given, how precise our estimates are, even in the reduced-form case, our results lend credibility to this assumption. If a dictator as brutal as Stalin indeed behaved rationally, then economic incentives, such as economic sanctions, can be effectively employed to deter behavior of similarly despotic leaders. Hence, peaceful economic solutions to political conflict should receive serious consideration before more violent options are considered.

While focusing on dictatorships illustrates policymakers' preferences most clearly, our approach could be extended to other types of political institutions. Once the analyst identifies the policymaker for which the fatal trade-off is established, e.g. the elected officials in the case of democracy, existing methods or our approach could be used. Taking a closer look at how policymakers value citizens' fatality risk is an important endeavor, even in democracies. First, the policymakers' VSL gives information about how decision makers aggregate cit-

izens' WTP valuations. In particular, one could investigate whether the VSL of the median voter approximates the policymakers' VSL. Second, in absence of a pure democracy, decision makers may impose their own objectives, such as career concerns or other private interests, when making policy as opposed to merely implementing policies that follow from a particular way of aggregating citizens' preferences. In this case, understanding whether there are systematic differences in the valuation of citizens' fatality risk is vital for understanding how effective a particular set of political institutions are.

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Figure 1: The Great Terror and Policy-making in a Dictatorship

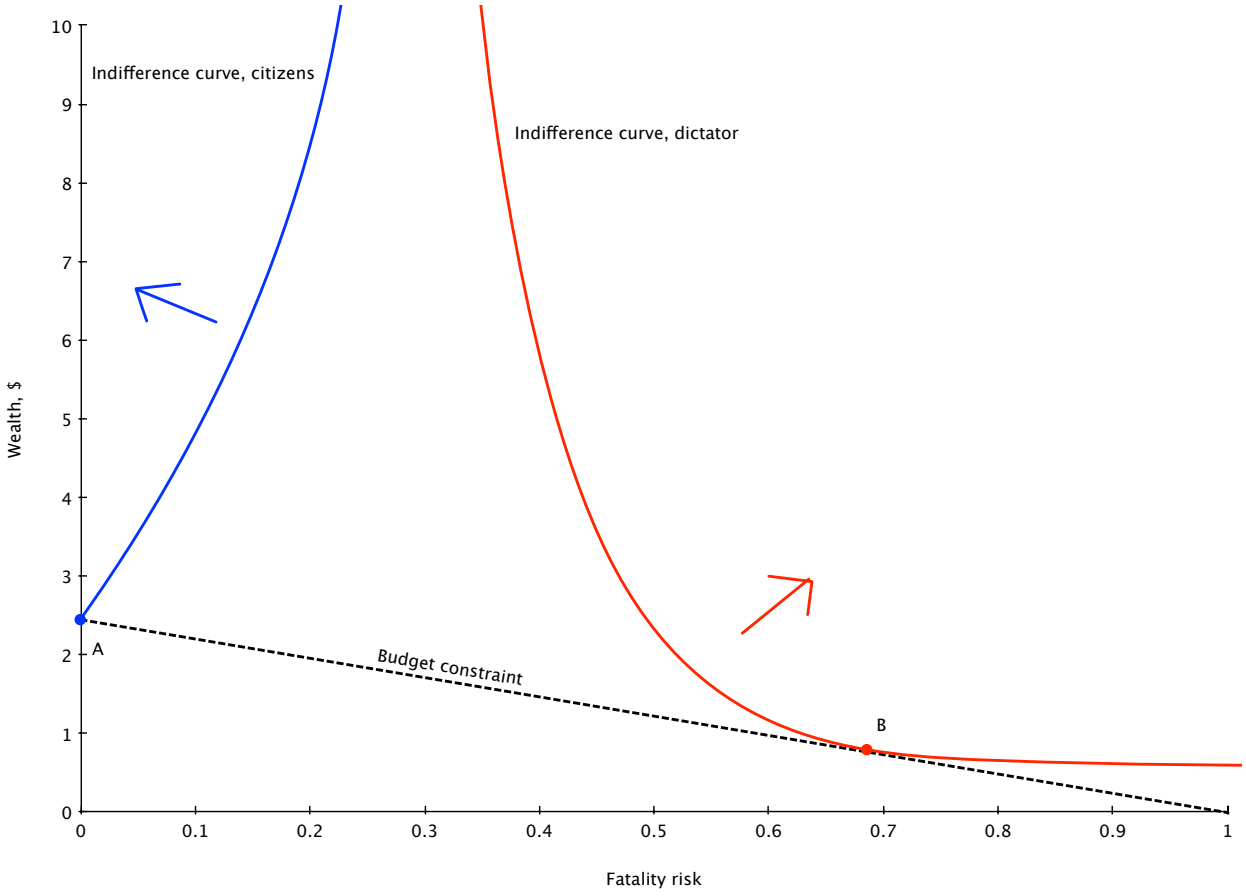


Figure 2: Hypothetical Great Terror and Policy-making in a Democracy

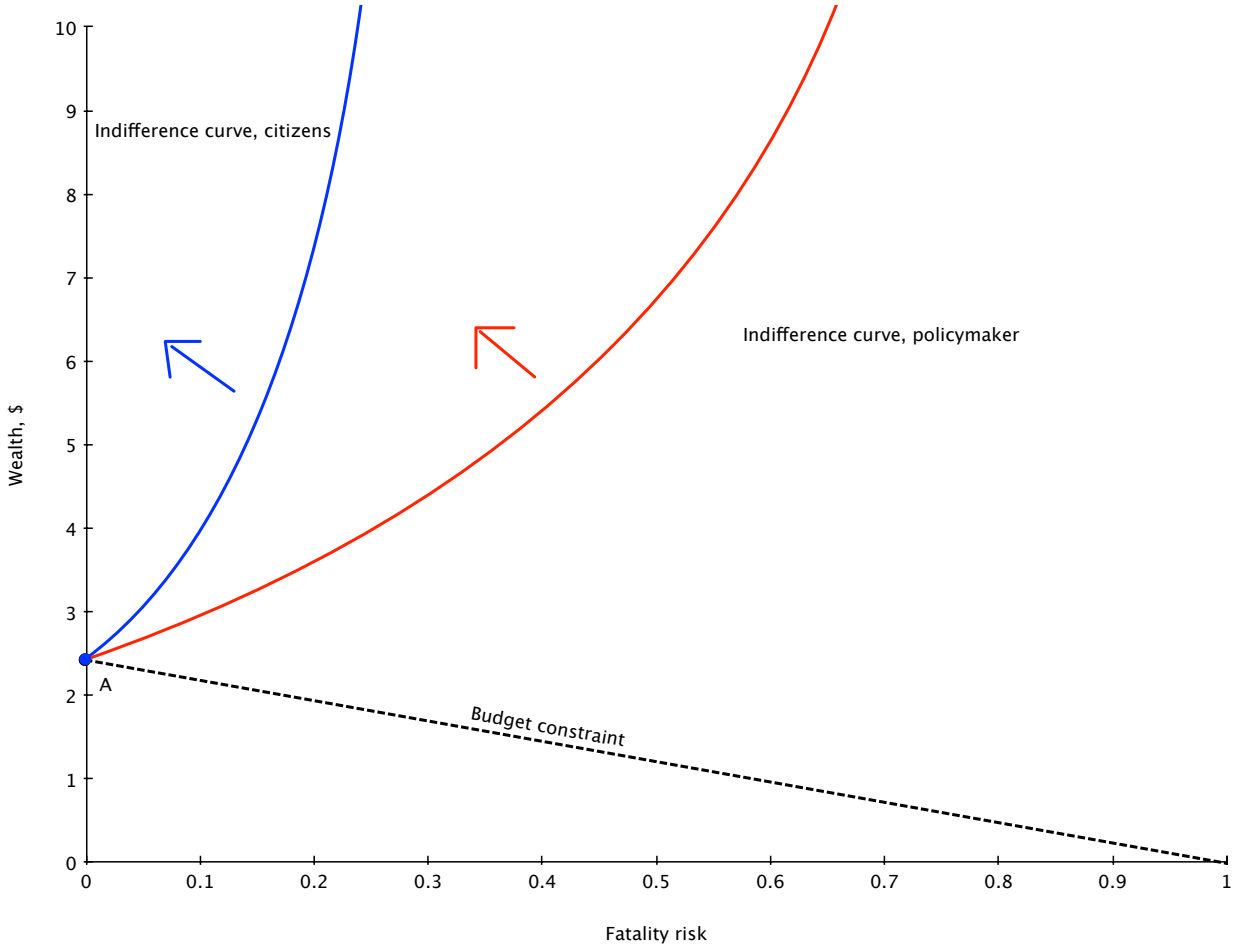


Figure 3: Counterfactual VSLD under alternative values of α

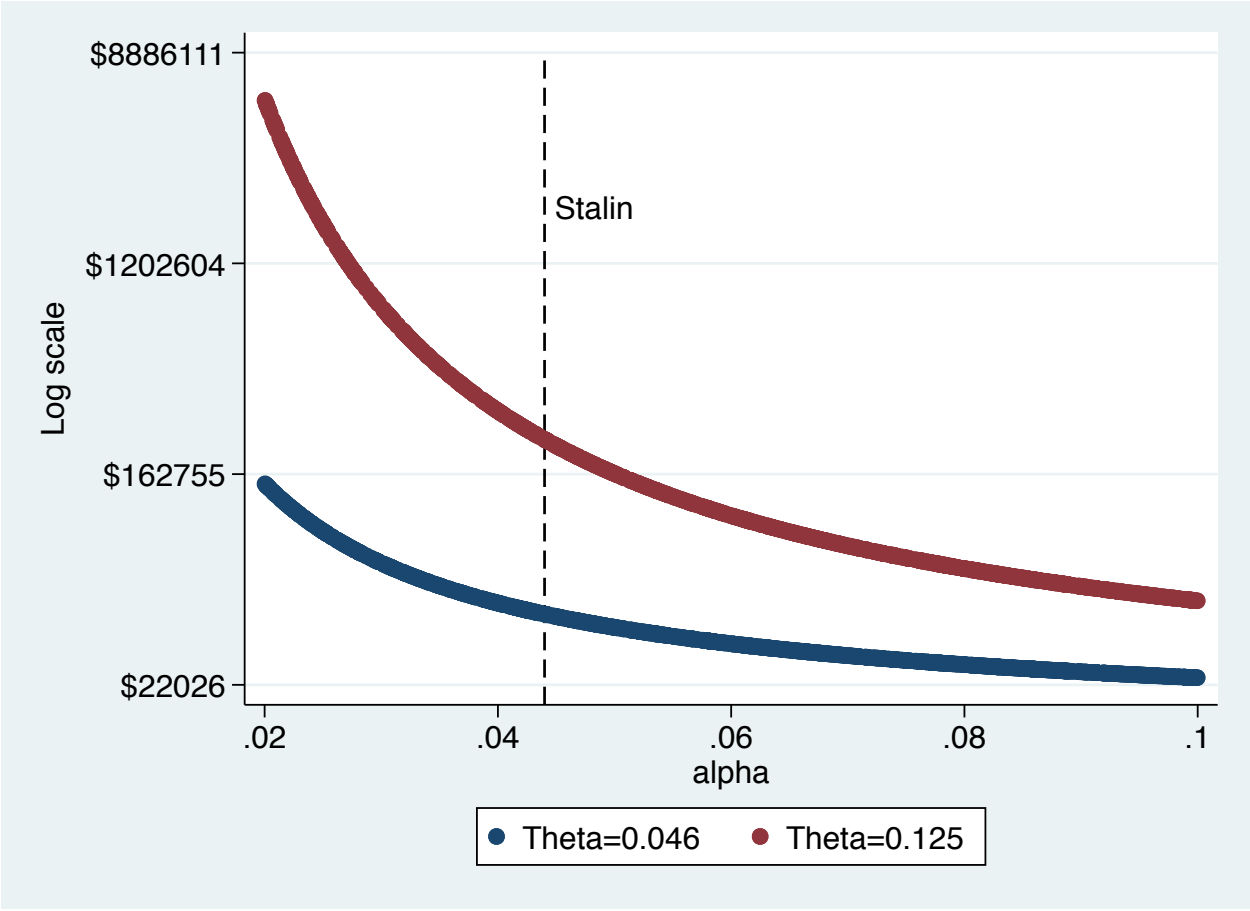


Table 1: Summary statistics of the Great Terror and Regional Characteristics in the late 1930s.

Variable	Obs	Mean	Std. Dev.	Min	Max
Arrests under German & Polish operations	58	3141.59	10474.42	22	77157
Executions under German & Polish operations	58	2511.34	8902.47	13	65332
All 1937-1938 arrests	55	24755.35	37155.18	1334	265692
Population	58	2876901	4141459	220684	30946218
Germans & Poles	58	38297	117984	500	827325
Germans & Poles per capita	58	.0179	.0791	.0004	.6058
Urban citizens	58	803665.5	1439908	29159	11190370
Illiterate citizens	58	953826.7	1173034	72030	8731250
Electricity output in 1937 (gigawatt hours)	56	640.6	1525.2	9.2	9265.3
Party members	52	43940.03	70511.08	3600	460644

Notes: Regional characteristics are for 1939 census year.

Table 2: Reduced form analysis

Dependent variable=	Politically repressed during German/Polish waves of terror				
	(1)	(2)	(3)	(4)	(5)
Border region	0.29**	-0.22	2.98**	3.15**	3.31
	[0.140]	[0.210]	[1.136]	[1.457]	[2.083]
Germans/Poles per capita	3.12***	2.14***	2.05***	0.79	-15.47
	[0.314]	[0.190]	[0.173]	[0.771]	[22.162]
Border region*Germans/Poles p.c.	40.51***	42.38***	32.50***	33.47***	48.19*
	[12.753]	[13.375]	[11.649]	[12.118]	[25.133]
Urban share		0.29	2.12**	1.14	2.17**
		[0.749]	[0.928]	[0.890]	[0.938]
Border region*Urban share			-4.53***	-3.48***	-4.57***
			[1.194]	[1.138]	[1.410]
Illiterate share		0.69	-0.26	-0.99	-0.41
		[0.416]	[0.456]	[0.628]	[0.682]
Border region*Illiterate share			-4.86**	-4.35*	-5.17
			[2.171]	[2.556]	[3.255]
Electricity consumption p.c.		1,027.14	442.37	319.75	591.65
		[626.124]	[548.872]	[689.656]	[797.020]
Border region*Electricity consumption p.c.			-126.80	-132.28	44.14
			[811.809]	[1,097.481]	[1,634.919]
All 1937-1938 arrests per capita				76.17*	90.68**
				[42.982]	[42.829]
Border region *All 1937-1938 arrests p.c.				-83.77	-88.29
				[50.871]	[57.277]
Party members per capita					-38.15*
					[19.830]
Border region*Party members p.c.					22.80
					[46.301]
Observations	58	57	57	57	52
R-squared	0.420	0.581	0.662	0.694	0.696

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Estimates of Stalin's preferences based on a policy of statistical repression

	Reduced-form	Structural: GMM		
			Calibrated parameters: θ	
	(1)	(2)	(3)	(4)
Weight on Economic Output, $\hat{\alpha}$	0.041	0.044	0.061	0.111
	$[-0.0256, 0.0993]$	$[0.0270, 0.1081]$	$[0.0610, 0.0612]$	$[0.1110, 0.1115]$
Strength of External Threat, θ	0.042	0.046	$\theta = .065$	$\theta = .125$
	$[-0.0249, 0.1103]$	$[0.0278, 0.1211]$		
No. of observations	58	58	58	58

Notes: The numbers in brackets are 95% confidence intervals. We obtain these intervals by bootstrapping. The number of identified victims in the GMM estimation is obtained by using the expected number of victims per capita based on estimates from nonborder regions.

Table 4: The Average VSLD

	Reduced-form	Structural: GMM		
		Calibrated parameters: θ		
Strength of External Threat, θ	$\theta = .042$	$\theta = .046$	$\theta = .065$	$\theta = .125$
	(1)	(2)	(3)	(4)
Border regions	\$43153	\$43151	\$43180	\$43183
	[\$43117, \$43169]	[\$43106, \$43170]	[\$43081, \$43206]	[\$43079, \$43211]
No. of Obs.	25	25	25	25
Strength of External Threat, θ	$\theta = .048$	$\theta = .0513$	$\theta = .10$	$\theta = .16$
Excluding North	\$43152	\$43150	\$43197	\$43201
	[\$43116, \$43172]	[\$43106, \$43170]	[\$42983, \$43235]	[\$42975, \$43241]
No. of Obs.	20	20	20	20

Notes: Present discounted value of per capita output $= \$2156/0.05$. The numbers in brackets are 95% confidence intervals. We obtain these intervals by bootstrapping. The number of identified victims in the GMM estimation is obtained by using the expected number of victims per capita based on estimates from nonborder regions.

Table 5: Robustness checks: Executed Victims and Album Procedure

	Executed Victims		Album Procedure Victims	
	OLS	GMM	OLS	GMM
	(1)	(2)	(3)	(4)
Weight on Economic Output, $\hat{\alpha}$	0.033	0.061	0.019	0.061
	$[0.0105, 0.0565]$	$[0.0610, 0.0612]$	$[-0.0022, 0.0409]$	$[0.0609, 0.0613]$
Strength of External Threat, θ	0.0347	$\theta = .065$	0.0197	$\theta = .065$
	(0.0112)		(0.0112)	
Average VSLD	$43147	$43166	$43140	$43157
	[$43121, $43162]	[$43064, $43187]	[$43119, $43152]	[$42994, $43181]
No. of observations	58	58	58	58

Notes: The numbers in brackets are 95% confidence intervals. For the GMM estimates of α and VSLD, we obtain these intervals by bootstrapping. The number of identified victims in the GMM estimation is obtained by using the expected number of victims per capita in nonborder regions.

Table 6: Robustness checks: Gulag, Transactions costs, Terror externality

	Gulag adjustment	Transaction costs	Terror externality
	$t = -0.07$	$t = 0.34$	$t = 12.57$
	(1)	(2)	(3)
Strength of External Threat	$\theta = .065$	$\theta = .065$	$\theta = .065$
Weight on Economic Output, $\hat{\alpha}$	0.0653	0.0462	0.0047
	$[0.0652, 0.0655]$	$[0.0462, 0.0464]$	$[0.0047, 0.0050]$
Average VSLD	$\$40164$	$\$57907$	$\$593251$
	$[\$40009, \$40187]$	$[\$57593, \$57956]$	$[\$563337, \$598268]$
No. of observations	58	58	58

Notes: The numbers in brackets are 95% confidence intervals. We obtain these intervals by bootstrapping. The number of identified victims in the GMM estimation is obtained by using the expected number of victims per capita based on estimates from nonborder regions.

9. INTENDED FOR ONLINE PUBLICATION

Appendix. An overview of the Great Terror

Coercion and state violence were important policy elements during the whole period of Stalin's rule. In an average year between 1921 and 1953, there were about two hundred thousand arrests and twenty-five thousand executions (figure A1). The years of 1937-38, known as the Great Terror, represent a clear spike in Stalin's repressions. Approximately, one and a half million Soviet citizens were arrested because of political reasons, including about seven hundred thousand who were executed and about eight hundred thousand sent into Soviet labor camps.

A reconstruction of a complete and detailed history of Stalin's repressions is still work in progress (see Unge, Bordukov and Binner 2008 for the most recent description of the Great terror policy). Many aspects of this policy remain still unknown. In particular, its spatial remains unknown. Regional data on "national operations" against Poles and Germans is an exception (Petrov and Roginiskii 1997; Okhotin and Roginskii 1999).

Historians distinguish between two waves of the Great Terror. The first wave which had started during the second half of 1936 and intensified after March 1937 was against the elite. The second wave against rank-and-file Soviet citizens, so called "mass operations", began in the summer of 1937 and continued till the late 1938 (Gregory 2009; Harris 2013; Khlevnuk 2010; Unge and Binner 2003; Unge et al. 2009). The first wave affected only a limited number of people and received a lot of attention in the Soviet press. In contrast, the second wave was conducted at a much larger scale but without any reference in the press.

Repressions against the Soviet elite, i.e. top party, state and military officials, affected several dozen thousand people; victims of ”mass operations” accounted for more than a million Soviet citizens. The first wave of terror included famous open Moscow trials on Stalin's former top political rivals, which followed by regional open trials and wide public campaigns against internal enemies during the late 1936 - 1937. The government tried to conceal the second stage of the Great Terror from the public, requiring secret implementation of the “mass operations.”

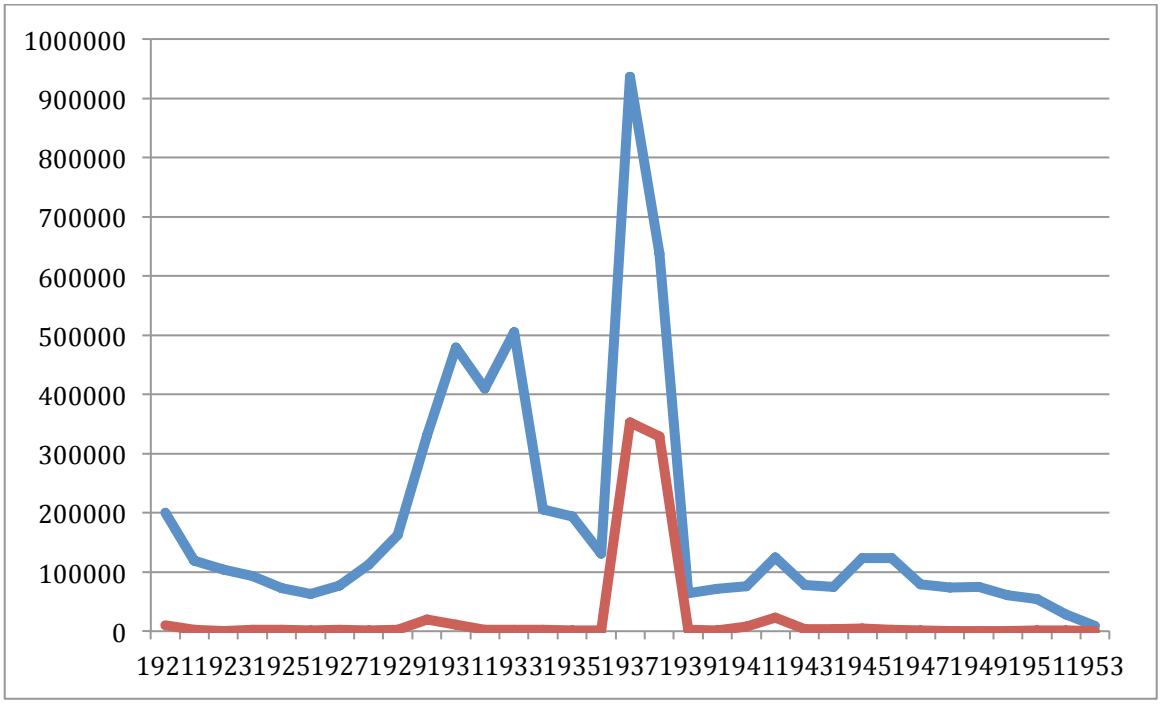
The Soviet archives clearly show that Stalin made the key decisions on the Great Terror. He personally approved execution lists for the elite and set regional limits for the “mass operations” (Gregory 2009). The “mass operations” were started and stopped by decrees initiated by Stalin. The Ministry of Internal Affairs (NKVD) issued the decree No. 00447 on July, 30 1937 (approved by Stalin and the Politburo of the Communist party) which launched the repressions against “former kulaks, former criminals and other anti-Soviet elements”. The decree prescribed the elimination of a particular number of enemies in each region. (Unger et al. 2010).

The Great Terror targeted particular groups of the population who, from the point of view of the Soviet government and Stalin, would most likely become traitors in case of a war. For them, disloyalty in the past was a proxy for potential disloyalty in the future. Members of social groups, which provided political support to the anti-regime forces during the Civil war or later (former kulaks, former members of non-Bolshevik parties, former gentry and clergy members etc.), were under risks of repressions. In addition, Stalin and his government viewed belonging to the same ethnicity as the dominant ethnicity of a potential

enemy-state as a proxy for disloyalty in the future that increased the probability of arrest for members of such ethnic minorities.

In the late 1930s, the Soviet government considered Poland, Germany and Japan as the most likely enemies in the next war. After the first "national operation" against the Poles (launched by the NKVD decree No. 00485 on 11 August 1937), Stalin gradually expanded "national operations" against almost all ethnic minorities with neighboring mother-states.

Figure 4: Political repressions in the USSR, 1921-1953



Source: State Archive of Russian Federation 9401/1/4157:201-205; published in GULAG. Vol.1 Moscow, 2000. Pp. 431-434.