Gulag, WWII and the Long-run Patterns of Soviet City Growth

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Abstract

This paper analyzes the geographical patterns of city growth in the Soviet Union and the Russian Federation in relation to the Stalinist policies of the 1930s to 1950s, and WWII. Using a unique data set on the locations of Gulag camps, and on the evacuation of industrial enterprises during WWII, I estimate the effect of these factors on city growth throughout the Soviet and post-Soviet period. The cities where Gulag camps were located grew significantly faster than similar cities without camps. WWII events (location of the frontlines, evacuation) also affected local population growth, but their impact diminished with time and disappeared completely after 25 years. In contrast, the effect of Gulag camps has been permanent.

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1 Introduction

Over the twentieth century the territorial distribution of economic activity and productive resources in the Soviet Union and Russia has changed dramatically. Both historical events and Soviet policies – notably the devastation of western parts of the USSR and the evacuation of people and enterprises during WWII, re-evacuation and reconstruction after the war, Stalin's industrialization and the build up of the industrial capacity east of the Urals, and Gulag, kulak and ethnic deportations – were driving these spatial shifts.

Still, largely because of the lack of of detailed data, we do not know much about how these historical events and policies changed the economic geography of the USSR and Russia. Were their effects short-lived, or did they persist over a long time? Could they still be economically relevant today? More generally, should we expect a return to a "normal" path of development after any exogenous shock, such as a war or "forced" policy, or can some of the shocks or policies be so drastic that they permanently affect the spatial development path?

In this paper, I analyze the patterns of city growth in the Soviet Union and the Russian Federation by constructing a unique dataset on the location of Gulag camps and the evacuation of industrial enterprises during WWII, and then matching those camps and enterprises to the nearest urban settlements. I therefore estimate the effect of WWII, evacuation, and Gulag camps on population growth in Soviet cities over a long time horizon. To my knowledge, this is the first paper that looks at both Gulag and wartime events in the context of regional population growth in the USSR using city-level data.

Working with city-level data allows me to investigate the spatial patterns of development on a much finer scale and over a much longer time horizon. While sub-regional and regional administrative boundaries have changed a lot during the Soviet history, cities are clearly defined administrative units. With a panel of city-level data for a long historical period, I can investigate the heterogeneity in population growth both between and within regions.

I find that the presence of a Gulag labor camp nearby is a strong predictor of future

population growth in Soviet cities. WWII events (fighting on the front, evacuation) also affect local population growth, but their effects are relatively short-lived, diminishing with time and disappearing after about 25 years. In contrast, the Gulag camps have a permanent effect on city size. The cities where camps were located grew significantly faster and continued to grow faster long after the Gulag system itself was abolished.

This paper adds to two strands of the literature, the first of which is the literature on population geography and industrial location in the USSR and the Russian Federation. A number of existing papers analyze regional investment patterns and population growth over the different periods of Soviet history: Hooson (1968) describes patterns of city growth prior to and after the October revolution; Harrison (1988) and (1990) discuss the reallocation of the Soviet industry to the eastern regions of the USSR prior and during the WWII; the ideological principles of Soviet location policy and their actual realization were considered in Dienes (1972), Dyker (1983), Huzinec (1977), and Rodgers (1974), among others; Andrienko & Guriev (2004) and Kumo (2006) studied interregional migration flows in Russia after transition.

The existing literature on Soviet economic geography relies mainly on region-level data analysis, except for the analysis of Soviet population dynamics by Gang & Stuart (1999) and Iyer (2003). Gang & Stuart (1999) study the growth of cities in terms of migration restrictions in the USSR during the period from the 1930s to the 1980s. They find little or no effect of these restrictions on population growth. I confirm their results for the wider sample of cities, with more recent data, and a different methodology. Iyer (2003) looks at the rank-size distribution of Russian cities and finds an increasing concentration of urban population after the transition to a market economy.

The second strand of literature I add to deals with the dynamics of population and industry in a series of historical "natural experiments." Since Krugman (1991), theoretical models of New Economic Geography predict the possibility of multiple stable equilibria in a spatial economy. Yet the stability of equilibria implies that once an agglomeration is formed

in one location, it is difficult to change the spatial allocation of productive resources, even if an alternative location is equally (or even more) suitable for concentrated economic activity. Only large shocks to the spatial structure of the economy have the potential to trigger a switch between equilibria. By looking at the wartime and post-war data, researchers can observe how population and industrial geography change after a significant exogenous shock, and determine whether wartime destruction can indeed trigger the switch between spatial equilibria.

Davis & Weinstein (2002) and (2008) investigate the long-term dynamics of population and industry location after the shock of WWII destruction in Japan using city-level data. Brakman, Garretsen & Schramm (2004) and Bosker, Brakman, Garretsen & Schramm (2007) look at German cities after WWII. Miguel & Roland (2011) look at the regions of Vietnam and their recovery after U.S. bombing. In this literature, one common finding is that wartime destruction has little or no effect on regional patterns of population growth, industrial geography, or regional development in the long run. Regional population levels tend to recover within 15-25 years after a shock. While this is true for Japan and Vietnam, West Germany exhibits only partial reversion toward the pre-war levels. The robustness of this result may suggest that the multiplicity of equilibria is either a purely theoretical notion that does not normally occur in reality, or that even drastic wartime shocks are not large enough to motivate a switch between equilibria.[1]

So far, the division of Germany after WWII is the only historical event researchers have studied in which an exogenous shock resulted in permanent changes to the spatial economy landscape. Redding, Sturm & Wolf (2011) find evidence of a multiplicity of equilibria in the location of Germany's air travel industry. The switch of equilibrium was triggered by the post-WWII division of Germany, but its reversal was not triggered by the reunification of Germany in 1990. Redding & Sturm (2008) find persistent long-term negative effects of Germany division for the West German cities near the newly established border with Eastern

[1]Interestingly enough, East Germany does not exhibit mean reversion, presumably due to the heavy influence of socialist planning after WWII. See Brakman et al. (2004) for more details.

Germany. It is not wartime destruction that affected the relative sizes of German cities in the long run, but rather the changes in their market access (market potential).

The Soviet Union presents a unique case for studying the effects of war on the spatial economy and radical regional policy. On one hand, like many other countries the USSR suffered direct effects of WWII: destruction of its capital and infrastructure and loss of lives. On the other hand, during the 1930s to 1950s while capital and infrastructure in the USSR were destroyed in the western regions they were being built up in the other parts of the country, mainly in the east. Relocating people and capital across the country, Stalin used policy to create industrial centers from scratch in places where they would hardly have emerged as the result of free migration of small economic agents (people, firms) in a market economy. Similar to the division of Germany, this served as a shock to market potential, but it was a different type of shock: agglomeration externalities were not exogenously destroyed (as in case of cities on the border between West and East Germany), but rather were created.

My findings on the effects of the war confirm the earlier literature: the impact of wartime destruction, however devastating it might have been, was temporary. On average, Soviet cities affected by the war eventually recovered. In contrast the Gulag, like the division of Germany, presents an example of permanent change in the spatial economy landscape. Redding et al. (2011) point out that even if multiple equilibria in industrial location are possible, in order to switch equilibria the shock to industrial location has to be not only strong but also perceived by economic agents as permanent. Soviet location policy (as proxied by Gulag) is a perfect example of such a significant change which was thought to be permanent at the time.

The rest of the paper is organized as follows. Section 2 presents a historical account of Soviet population and industrial geography. Section 3 describes the data. Sections 4 to 6 analyze the data and report the results. Section 7 concludes.

2 The History of Gulag, Wartime Evacuation, and the Spatial Evolution of the Soviet Economy

Gulag

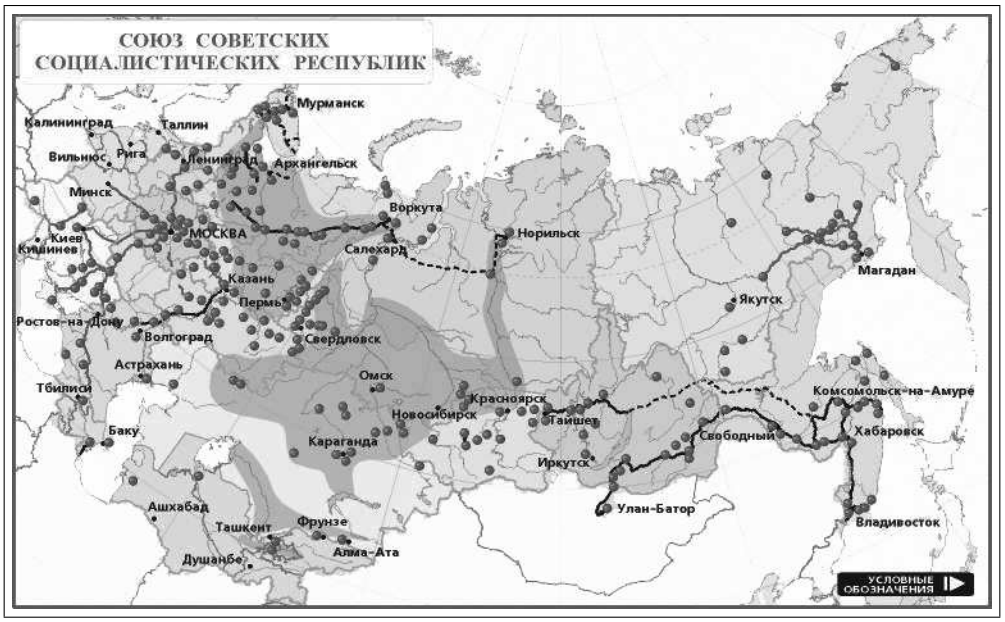
Gulag (a collection of penitentiary institutions) has its roots in the Russian Civil war period of 1917-1922. The first concentration camps, where prisoners' labor was used for "community service," were established as early as 1919. In the beginning, the primary purpose of these camps was punishment, not economic activity. That doctrine changed as the 1930s began. Ivanova (2006) cites a joint memo from the People's Commissariats of Justice and the Interior and the Joint State Political Directorate ($OGPU$) to the Council of People's Commissars of the RSFSR dated April 1929 proposing *"1. To use prisoners serving a term of 3 years or more in colonization of our northern frontier territories and in developing the natural resources there."*[2] Thus Gulag became a tool of regional development in the early 1930s.

At the same time, the number of camps and the total prisoner population began to grow rapidly, from 179 thousand prisoners in 1930 to almost 1.9 million in 1938.[3] Gulag population continued to grow steadily until Stalin's death, with the peak number of prisoners, 2.5 million, in 1952. From 1935 to 1952, the Gulag system was responsible for 6-10% of all construction in the USSR.[4]

Figure 1 illustrates the geographical location of the Gulag camps. Although originally in remote locations, camps eventually were organized in practically all areas of the country. In fact, a Gulag map looks much like the map of population density.

The largest camps were established at the sites of major infrastructure projects that required a lot of labor. Not all of these camps were in the remote areas; of the ten biggest camps, six were west of the Ural mountains and three were in or near major cities. Table 1 gives some examples of the location and major activities of the largest camps.

[2]Author's translation, source: Ivanova (2006), page 161.
[3]Data compiled from NKVD documents, cited in many sources, including Applebaum (2003).
[4]Source: Khlevnyuk (2004), page 25.



Source: Smirnov (1998), map online at www.memo.ru.

Figure 1: Gulag camps in the USSR.

Camp name	Location	Max capacity, thousand people	Capacity rank	Years of operation	Primary activity
Baikal--Amur ITL*	Svobodnyi, Amur oblast 110 km north-east of Blagoveshensk	201	1	1932-1938	Construction of Baikal-Amur railroad
Severo--Vostochnyi ITL	330 km north of Magadan	190	2	1932-1949	Gold mining
Dmitrovsky ITL	Dmitrov, 50 km north of Moscow	189	3	1932-1938	Construction of Moscow-Volga canal
Dalne--Vostochny ITL	Khabarovsk	112	5	1929-1939	Railroad construction, coal mining, gold mining
Belomoro--Baltiisky ITL	Medvezh'egorsk, 120 km north of Petrozavodsk	108	6	1931-1941	Construction of "Belomorkanal"
Volzhskii ITL	Rybinsk, 83 km north--west of Yaroslavl	88	8	1935-1942	Construction of hydroel. power plant and canal infrastructure
Bezymyanskii ITL	Samara	81	9	1941-1946	Industrial construction
Sibirskii ITL	Mariinsk, 130 km north--east of Kemerovo	78	11	1929-1960	Logging, road construction

*"ITL" is a transliteration of a Russian acronim for *ispravetelno-trudovoi lager'* (correctional labor camp).

Table 1: Some of the largest Gulag camps

A stereotype of a Gulag camp is a remote location with a hostile climate and no infrastructure, but looking at the newly systematized data on camp locations paints a different picture.[5] A vast majority of the camps operated in or near cities or towns. Figure 2 shows the distribution of camps in terms of distance to the nearest population center with the status of city: 83% of all camps were located no more than 35 kilometers from a settlement with city status now, and 66% of all camps were no more than 35 kilometers from a city of at least 10,000 inhabitants in 1939 (Figure 3). Thus, we can effectively conclude that Gulag was mainly an urban phenomenon.

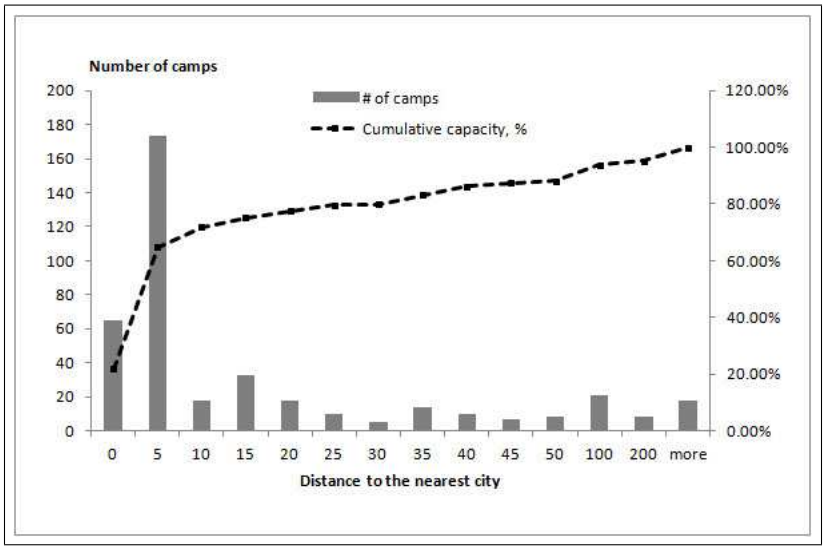


Figure 2: Number of Gulag labor camps by the distance to the nearest population center.

Camps tended to be located near larger cities. If we compare the distributions of cities with and without Gulag camps nearby, we can see (in Figure 4) that the histogram of city sizes is heavier on the right tail for the group of cities with Gulag. Remote camps, and camps near small settlements, on average were larger by capacity (number of prisoners), but that correlation was not very strong (see Figure 5).

In general, as a tool of regional policy Gulag helped to shift productive resources from the

[5]The main source of Gulag data is Smirnov (1998), digitized for this paper.

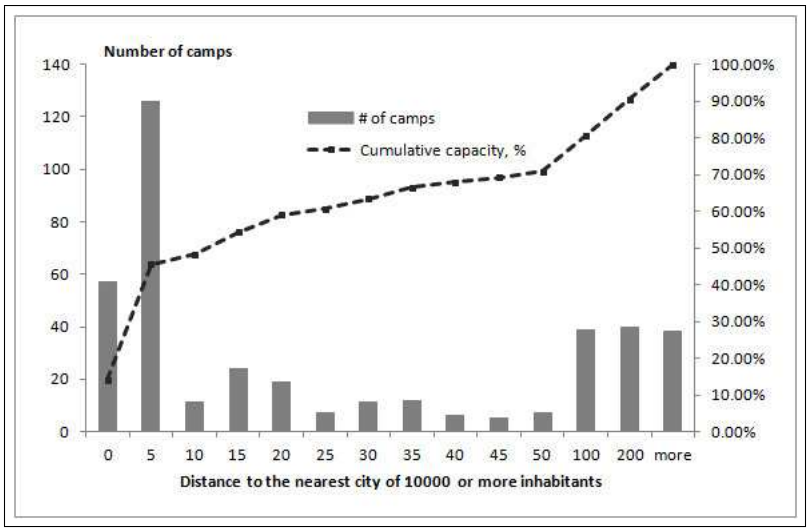


Figure 3: Number of Gulag labor camps by the distance to the nearest population center of 10 000 people or more in 1939.

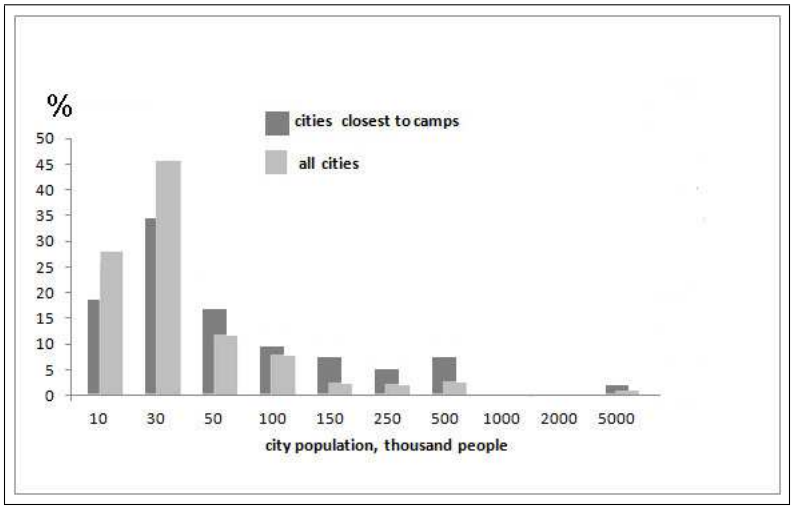


Figure 4: Cities with Gulag camps nearby vs. all cities, 1939.

western parts of the USSR to the remote corners of the country, and from small settlements and the countryside to larger cities and new cities. In the introduction to his volume (page 10), Khlevnyuk (2004) notes that although the primary purpose of Gulag was penitentiary,

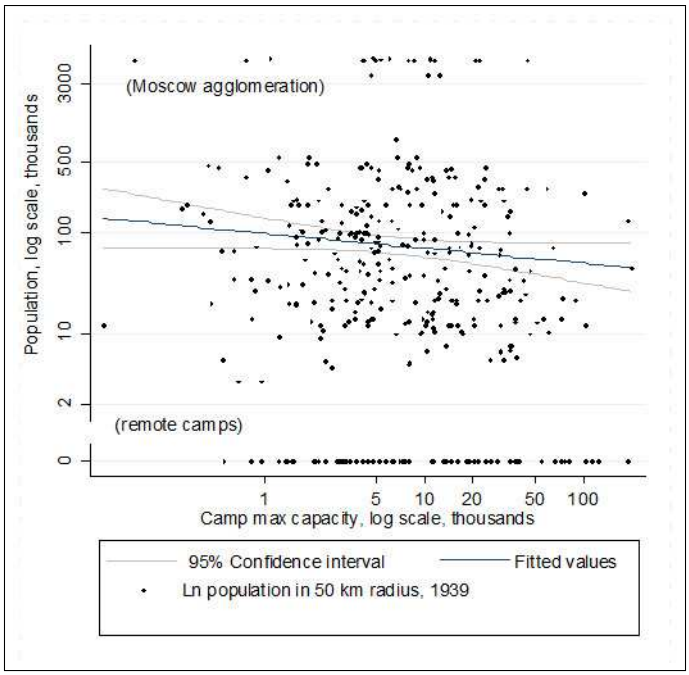


Figure 5: City size in 1939 and total max capacity of Gulag camps in 50 km radius.

its sheer amount of "cheap" prison labor allowed for the initiation of investment projects that hardly would have been possible had the Soviet government have to recruit voluntary labor there. Numerous documents underline the shortage-of-labor motivation in the creation and expansion of Gulag camps.[6] Thus, geographically, the presence of a Gulag camp near a city or town points to a local deficit of voluntary labor in the 1930s to 1950s. This deficit, of course, was artificially created by Soviet planning itself and existed because of state-controlled wages. In fact, Gulag camp may be a good indicator that some investment project was undertaken nearby, and that the location was favored by the Soviet government for industrial development.

[6]For example, Khlevnyuk (2004) cites a telegram to Stalin from the Secretary of the Far Eastern Regional Committee of VKP(b) on the construction of metallurgical plant in Komsomolsk-na-Amure: "...the work for 1936 would require above 10 000 workers at the construction site, which could not be met by the local labor force balance. An expensive recruitment of workers from other parts of the (Soviet) Union would be required, and when they arrive – we'd need to start construction of housing and service facilities... That is why we believe the best solution is to transfer the construction of the metallurgical plant to the Far Eastern NKVD camps..." (page 115-116, author's translation).

WWII evacuation

The Soviet government[7] evacuated production lines and people (with priority given to skilled industrial workers and engineers) from the western territories in the first days after the German invasion. Thus, the first years of WWII resulted in a significant shift in regional industrial structure, from both the destruction and from this evacuation. A number of cities in the Soviet East received a significant positive shock to productive capacity, population, and human capital. Evacuation was also a major shock to regional population shares.

To my knowledge, the geography of wartime evacuation has never been studied in detail because the data were not available to the public. In public discourse, evacuation was long viewed as one factor that fueled the development of the eastern regions.But in reality there was no statistical evidence one way or the other that the cities that received evacuated enterprises indeed grew faster, simply because the detailed data did not exist in the public domain. In addition to the unavailability of the data, there is another challenge in accounting for the effect of evacuation: it has to be disentangled from the effects of the Soviet location policy in general. Evacuation, and the sudden change in the Soviet economic geography that it brought, were not spatially random.

Harrison (1990) emphasizes Stalin's conviction that his pre-war policies contributed greatly to the USSR's victory. Lieberman (1983) also notes that from the beginning of 1930s, one of the goals of Stalin's industrialization clearly was to build up industrial capacity deep in the Soviet territory, in the Urals and eastward, where it would be safe from invasion. These plans were only successful to a certain degree. The western parts of the USSR were the traditional industrial core of the Russian Empire. It would be difficult to shift the industrial base away from regions with a relative abundance of installed capital and skilled labor. As Harrison (1990) argues, despite the efforts of the Soviet government, the shift of industry eastward prior to the war was insufficient from the defense point of view.

[7]Central Committee of the Union Communist Party (bolshevik) and the Council of People's Commissars of the USSR, "On the order of evacuation and relocation of the people and valuable resources", June 27, 1941.

Of course, the hurried evacuation in the first months of the war was a dire necessity, but it was also a forced implementation of an existing plan.

One indirect piece of evidence for the "preexisting plan" argument is that many of the evacuated plants either never moved back or continued to operate at both the new and old sites after the war. Of the 1374 enterprises for which I have information, only 453 have a record of being reestablished in some form at the old site after or during the war. Most commonly in the case of restored enterprises, instead of one enterprise two were operating after the war: one at the old and one at the new site.

Many of the cities to which enterprises were evacuated also hosted Gulag camps (the correlation between indicators of evacuation and Gulag on territories far from the frontlines is 41%; in the Urals, it is 46%). Naturally, if Gulag prisoners could easily be used to relieve the local deficit of labor, than the enterprises should be evacuated to where labor was easier to find in the war economy. This also suggests that the geographical allocation of the evacuated enterprises correlated strongly with the pre-war allocation of investment.

The summary statistics are: 1) enterprises were evacuated from 116 different cities to 190 different cities; 2) the main evacuation destinations were large cities – out of the top-20 destinations, 18 were *oblast* centers. However, many small settlements also received enterprises. Table 2 presents several examples of the destination cities and their population in the census years before and after the war. It was not uncommon for a city to increase its population by several hundred percent between these two censuses.

I attempt to disentangle the effects of Gulag, wartime destruction, and evacuation in order to determine how much of the change in population can be attributed to each of these known factors. Section 3 describes the data sources in greater detail.

City	population 1939, thousand	population 1959, thousand	number of enterprises received	rank by the # of enterprises	location
main destinations					
Sverdlovsk (now Ekaterinburg)	475	881	114	1	
Novosibirsk	427	927	71	2	
Kazan'	418	647	66	3	
Ufa	258	547	65	4	
Kuibyshev (now Samara)	408	902	55	5	
smallest city-destinations					
Pokhvistnevo	6.6	23	1	129-190	Kuibyshevskaia oblast'
Tsivil'sk	5.1	5.9	1	129-190	Chuvashskaia ASSR
Chebarkul'	3.7	31	1	129-190	Cheliabinskaia oblast'
Kataisk	2.8	12	1	129-190	Kurganskaia oblast'
Ukhta	2.7	36	1	129-190	Komi ASSR

Table 2: Some examples of city-destinations in WWII evacuation.

3 Data

Population

The population data come from censuses in the Russian Empire (1897), the USSR (1926 - 1989), and the Russian Federation (2002, 2010). For census years 1959 and 1939, the data come from Harris (1970); for all other years, from the original census publications. In all of the years, the sample includes all population centers with a city status and some of the larger rural settlements. 2002 and 2010 cross-sections include all urban population centers (cities and urban-type settlements) and rural settlements of 15000 or more.

Overall, the unbalanced panel has 9 time points (census years). The sample grows from 534 cities (*uezdnye goroda*) in 1897 to 2,002 cities and sizable rural settlements in 2010. Thirty-four small settlements with a city status are missing from the sample for 1926-1979 because they were omitted from the original publications.[8]

[8]Cities were omitted either because the population size dropped below the publication threshold for a particular census year, or for secrecy reasons. Examples are "closed" towns (centers of defense-related

The administrative boundaries of a city in the USSR were not fixed. As cities grew, new land was added to the city territory, surrounding villages and small towns disappeared (in an administrative sense), being incorporated into larger population centers. Thus with the possible exception of the large agglomerations, the official city population data quite accurately reflect the size of an integrated urban economic area. For Moscow, St. Petersburg, Ekaterinburg, Novosibirsk, and Nizhnii Novgorod, I calculate the population of the agglomeration area, including all satellite cities and towns within a 30 km radius.

Gulag Camps

The main source of data for Gulag prisons and labor camps is a publication by the Russian human rights organization *"Memorial"* (Smirnov (1998)), itself based on the archival sources. It documents geographical location, presents estimates of the number of prisoners in different years, and describes the main purpose of the camp or the economic activity that used the prison labor. There were 475 camps on the territory of the Soviet Union; we know the location of 460 of them is known; 408 were located inside the modern borders of the Russian Federation.

I record the geographical coordinates for all of the camps with known locations. Then, I use those coordinates to match population centers in the Russian Federation (cities, towns, villages, settlements) to nearby Gulag camps. I record the distances from each city to the nearest Gulag camp, and from each camp to the nearest city. In the 1939 sample 46% of settlements with the status of city had a Gulag camp within 50 km or closer.

I categorize the camps according to a verbal description of their specialization. The four main camp categories are: construction, industrial production, mining (resource extraction), and agriculture and forestry (mainly logging operations). I split construction activities into: construction of industrial establishments in the primary sector, other industrial construction, construction of housing, and construction of infrastructure. Some of the highly specialized

research), or some towns in the area affected by the famine of 1933 that were deliberately excluded from 1939 census publications by the Soviet authorities.

camps, the prisoner sorting centers (*peresylnye centry*), and the camps without a description are not included in any of the groups.

WWII Losses

WWII dramatically affected the economic geography of the Soviet Union. The western parts of the country were occupied by the Nazi Germany and suffered the greatest losses. Soviet sources report the loss of 25% of the population in Belarus and up to 20% of the population in Ukraine.[9] It is likely that the occupied regions of the Russian Federation suffered similar human losses. Unfortunately, detailed data on wartime losses by city or region in the USSR does not yet (and possibly never will) exist in the public domain. It is not possible to infer human losses from census data, because the first population census after the war was in 1959, 14 years after the war ended. Neither data on destruction of infrastructure and capital nor information on restoration efforts by city or region ever were publicized. I can only construct several simple indicators of the impact of WWII, based on the geographical location of the city.

I construct three dummy variables on city location to single out population centers that suffered from the war. First is an indicator that a city was occupied by the Germans at some point during WWII. A second indicator includes all occupied cities and cities in close proximity to the front lines (30 km). This way, we include cities that might never be formally lost by the Soviet Army, but which could be severely damaged by bombings and artillery fire. A third indicator includes all occupied cities and all cities within 200 km of the front lines. This range should cover the majority of bombing targets.[10]

In my 1939 sample, 245 out of 772 cities (or 31%) were occupied by Nazi Germany, and 457 (or 59%) were at least 200 km from the front lines at some point during WWII.

[9]For example, *"Belorusskaya SSR za 20 let (1944-1963)"* ("Belorussia during 20 years") Minsk, Statistika, 1964 reports that total population of Belarus SSR in 1939 was 8.9 million; losses of Belarus population during the war were more than 2.2 million people. The loss of civilian population only in Ukraine is reported as 16% of total. Source: "Ukraina za 50 rokiv" ("Ukraine during50 years"), Central Statistical Unit with the Government of Ukrainian USR, Kiev 1967.

[10]Source of maps: Andronikov (1975).

WWII Evacuation

My source of data on evacuations is Dexter & Rodionov (2012), the database of the Soviet military-industrial complex. Practically all functioning enterprises in the USSR produced defense-related products in 1941-1946, and therefore are included in the database. According to Kozlov (1985), 2,593 enterprizes (1,523 of them classified as "large") were moved to the eastern regions of the USSR, and of these 1,523 large establishments, 1,215 were sent to the Urals, Volga region, and Siberia, i.e. to the territories that now belong to the Russian Federation. Unfortunately, there is no information on the geography of small enterprise evacuation. In the Dexter & Rodionov (2012) database, I found 1,374 establishments (either large or small) that were relocated to 190 cities within the borders of modern Russian Federation. Although the data are definitely incomplete, they account for a majority of the evacuated enterprises.

For each city, I record the number of establishments evacuated from the city in 1941-1942, the establishments evacuated to the city, and the establishments returned from evacuation in 1942-1948. Unfortunately, it is not possible to estimate the size of the evacuated enterprises, because the data on employment, capital, or production volume are not available. Thus, only enterprise count variables and indicator variables for each city are constructed.

4 Data Exploration

In this section, I look at the general patterns in the data, describing in very general terms how cities affected by Stalinist policies and the war differ from the control group of cities.

My first step is to match the cities to the Gulag camps. Figure 6 plots the change in a city's log-population against the distance to the nearest camp. There is a lot of heterogeneity in city growth, but on average cities closer to Gulag grow faster. The effect gradually diminishes and levels off at about 50 km. I choose a 50 km radius as the main threshold for all further analysis. Cities with a camp within 50 km or less are considered the treatment

group, the rest are the control group.[11]

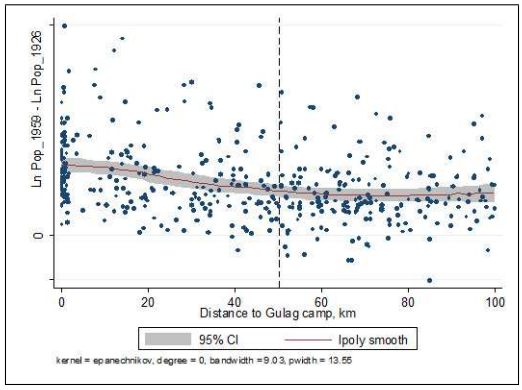


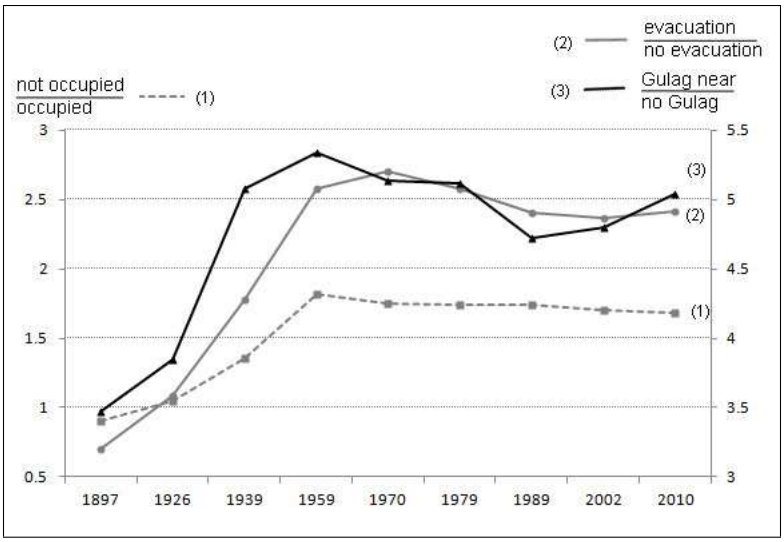
Figure 6: City growth under Stalin and distance to Gulag: local polynomial smoothing.

Next, using this definition of Gulag cities, I compare the simple averages of city size. Figure 7 illustrates the difference in average city size between cities that were affected by WWII and Gulag relative to the control group. Clearly, the control group and treatment groups were inherently different. Cities picked to house evacuated enterprises or Gulag camps were larger than average in the 1920s. In the following decades, the gap between the treatment and control groups widened even more.

It is clear from the graphs that there is a difference in the dynamics of population geography during Stalin's time and after Stalin: the dynamics of city growth shows a clear structural break in 1959 (which is the first census year after Stalin's death). The pre-war period (1926-1939) and 1939-1959 look very similar. Cities that received evacuation were growing faster than average even before the war. The same is true for the cities that were not occupied. This illustrates the general eastward bias of Soviet industrialization in the 1930s. Emergency wartime measures and the shift in the Soviet economic geography in the 1940s-1950s do not look like a sudden structural break, but rather continue the pre-war trend. Whether this difference in the trajectories of city growth exists because of Soviet location policy *per se* or because cities were inherently different is a question to be investigated.

In the rest of the paper I estimate the effect of Gulag, evacuation, and the war, con-

[11] I did robustness checks with 20 km threshold, the results are either the same or stronger.



Graphs show: (1) ratio of the average size of a city that was not occupied in WWII relative to the average size of a city that was occupied (left scale),
(2) ratio of the average size of a city that received evacuated enterprises vs a city that did not (for the cities that were not occupied) (right scale),
(3) ratio of the average sizes of cities with and without a Gulag camp in less than 50 km (right scale).

Figure 7: Difference in city sizes by WWII occupation status, evacuation, and presence of Gulag.

trolling for heterogeneity in city characteristics. First, I use individual effects the in panel estimations; then, I use matching estimations.

5 Panel Estimations

In this section, I estimate a series of panel models on city growth data, using a difference-in-difference methodology. I compare the average trajectory of city growth in the treatment group (a subset of Russian cities that are affected by WWII, evacuation, or Gulag) with the control group (other cities), controlling for unobserved heterogeneity by individual (random) effects. The empirical specification is:

$$g_{it} = \alpha_t + \beta\, Treatment + \sum_s \gamma_s (Treatment \times Period_s) + \delta_i + \epsilon_{it}, \qquad (1)$$

where g_{it} is an annualized growth rate of city's population during a given time period; $Treatment$ is an indicator whether city i was affected by Gulag, WWII fighting or evacuation; $Period_s$ is a time periods indicator; α_t is a period-specific intercept, ϵ_{it} - random error. δ_i - random effects, included to control for all heterogeneity specific to the city, apart from the $Treatment$. To trace changes in city growth patterns, I include the set of time-treatment interaction terms for all periods (with 1897-1926 as an omitted benchmark).

The results are shown in Tables 3 - 5. Table 3 summarizes the results for WWII occupation and being close to the front lines. As expected, the time period that includes the war years (1939-1959) admits a negative coefficient for treatment: cities that were affected by the war grow more slowly. From 1959 to the 1980s, the affected cities recover, catching up with the control group in terms of population. But the biggest decline in the growth rate of the cities that would later be occupied by Nazi Germany, or be close to the front lines, comes in the pre-war period of 1926-1939. It is not the war itself that is responsible for the divergence between the growth trajectories of eastern and western cities. Rather, the shift of population from the west to the east intensified in the late 1920s to 1930s, during the pre-war industrialization period.

Table 4 shows estimation results for the wartime evacuation of industrial enterprises. For cities that received evacuated enterprises (column (1)), the treatment variable has a positive and significant coefficient. But the time period that includes the war years (1939-1959), or the post-war period, is not significantly different from the benchmark. Cities that received evacuation were inherently attractive and grew faster than average. Yet according to my estimations, evacuation itself had little or no effect on their growth (column (1)).

In columns (2) and (3) the sample is split by city size. Large cities (more that 100 thousand inhabitants in 1939) do not gain from evacuation. Medium cities (between 6 and 100 thousand inhabitants) grow faster in 1939-1959, and somewhat more slowly after that (but the difference is not statistically significant). Finally, in column (4), the specification includes not just a binary evacuation indicator but also a number of evacuated enterprises

Dependent variable is an annualized growth rate of a city between two census years, %.

Treatment	occupied in WWII			30 km to front	200 km to front
Indep. variable	(1)	(2)	(3)	(4)	(5)
Treatment	-0.017	-0.017	-0.070**	-0.105**	-0.080
	(0.018)	(0.029)	(0.020)	(0.046)	(0.050)
Treatment ×					
1926-1939	-0.230**	-0.230**		-0.150**	-0.226**
	(0.051)	(0.089)		(0.064)	(0.067)
1939-1959	**-0.163****	**-0.164****	**-0.117****	**-0.082**	**-0.168****
	(0.033)	(0.049)	(0.032)	(0.053)	(0.057)
1959-1970	0.111**	0.111**	0.158**	0.147**	0.120**
	(0.021)	(0.031)	(0.023)	(0.052)	(0.057)
1970-1979	0.047**	0.047*	0.094**	0.092*	0.056
	(0.018)	(0.027)	(0.021)	(0.048)	(0.053)
1979-1989	0.032*	0.033	0.080**	0.097**	0.058
	(0.017)	(0.026)	(0.019)	(0.047)	(0.051)
1989-2002	0.053**	0.053*	0.100**	0.150**	0.116**
	(0.017)	(0.027)	(0.021)	(0.046)	(0.051)
2002-2010	0.015	0.015	0.063**	0.101**	-0.077
	(0.016)	(0.026)	(0.018)	(0.045)	(0.050)
Year effects	yes	yes	yes	yes	yes
Years	1987-2010	1987-2010	1987-2010	1987-2010	1987-2010
Number of obs	5636	5636	5636	5636	5636
Errors clustered on	city	region	city	city	city
Number of clusters	763	87	763	763	763
R-sq overall	0.35	0.35	0.34	0.30	0.31

Robust SE in parentheses, ** - significant at 95% level, * - at 10% level

Table 3: The effect of WWII on city growth, panel estimations.

Dependent variable is an annualized growth rate of a city between two census years, %.

Treatment	enterprises evacuated to city				evacuated from city	did not return
Indep. variable	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	0.137**	0.163	0.014	0.122	0.126*	0.153**
	(0.051)	(0.114)	(0.059)	(0.081)	(0.068)	(0.078)
Treatment ×						
1926-1939	0.092	-0.002	0.134	0.143	0.189*	0.063
	(0.075)	(0.194)	(0.084)	(0.168)	(0.111)	(0.106)
1939-1959	**0.070**	**0.121**	**0.133***	**-0.129**	**-0.067**	**-0.191****
	(0.059)	(0.129)	(0.070)	(0.086)	(0.081)	(0.094)
1959-1970	-0.159**	-0.183*	-0.059	-0.152*	-0.095	-0.125
	(0.059)	(0.113)	(0.063)	(0.082)	(0.074)	(0.087)
1970-1979	-0.152**	-0.294**	-0.045	-0.159*	-0.116	-0.144*
	(0.052)	(0.143)	(0.061)	(0.085)	(0.070)	(0.081)
1979-1989	-0.137**	-0.177	-0.028	-0.146*	-0.143**	-0.151*
	(0.052)	(0.113)	(0.062)	(0.082)	(0.070)	(0.079)
1989-2002	-0.147**	-0.177	-0.050	-0.142*	-0.139*	-0.173**
	(0.051)	((0.117)	(0.061)	(0.083)	(0.071)	(0.086)
2002-2010	-0.121**	-0.177	-0.019	-0.099**	-0.088	-0.102
	(0.050)	(0.113)	(0.060)	(0.082)	(0.067)	(0.079)
Evacuated plants per 10000 people				-0.001		
				(0.081)		
Evacuated plants per 10000 people ×						
1926-1939				-0.104		
				(0.101)		
1939-1959				**0.138****		
				(0.067)		
1959-1970				0.054		
				(0.062)		
1970-1979				0.032		
				(0.063)		
1979-1989				0.028		
				(0.063)		
1989-2002				0.025		
				(0.061)		
2002-2010				0.001		
				(0.064)		
Year effects	yes	yes	yes	yes	yes	yes
Years	1987-2010	1987-2010	1987-2010	1987-2010	1987-2010	1987-2010
Observations	all,	large, no war	medium, no war	no outliers, no war	all occupied	all occupied
Number of obs	5636	437	2394	3072	2433	2433
Errors clustered on	city	city	city	city	city	city
Number of clusters	763	83	388	417	328	328
R-sq overall	0.35	0.55	0.34	0.42	0.26	0.25

Robust SE in parentheses, ** - significant at 95% level, * - at 10% level.

Table 4: Wartime evacuations and city growth, panel estimations.

per capita. Outliers with the most enterprises per capita (10 % of all cities that received evacuation) were dropped from the sample. The number of establishments does make a difference in city growth: cities that received more enterprises grew faster in 1939-1959.

Column (5) traces the growth trajectory of the cities that sent enterprises into evacuation. Again, the pre-war growth of such cities is higher than average, while growth in the 1940s-1950s is indistinguishable from the average. There are two factors that explain this. First, the westernmost regions of the USSR were occupied in the first weeks after the beginning of German invasion, and there was no time for evacuation of industry. Most of the evacuated enterprises came from regions somewhat farther to the east (Moscow, Tula, Voronezh – to name a few), and those areas were relatively favored in the pre-war shift of industry in the 1930s. Second, the most important enterprises were the first to evacuate. Cities hosting those enterprises were growing faster before the war, and were restored as soon as possible after the war. In contrast, cities where evacuated enterprises did not return after the war were not among the fast-growing prior to the war, and they lost population thereafter (column (6)).

Table 5 shows the results for Gulag camps near a city. Gulag cities are different from the control group, and the difference (as measured by the coefficient before $Treatment$) is larger than for the war or evacuation. Gulag cities also grow significantly faster in 1926-1939. Negative coefficients of treatment-period interactions after 1959 are not large enough to compensate. In sum, having a Gulag camp nearby increases city growth by more than evacuation or being spared in the war. Figure 8 plots implied indices of city size for three treatment groups relative to the control group: occupied cities, cities that received evacuated enterprises, and cities with a Gulag camp within 50 km.

One of the remaining issues is simultaneity of treatments. Both regional industrial policy priorities (as proxied by Gulag) and exogenous factors (such as the impact of WWII) work at the same time and in similar directions: pushing people and economic activity in the USSR to the east. It is likely that decisions by the Soviet authorities on where to locate industry, or

Dependent variable is an annualized growth rate of a city between two census years, %.

Treatment	Gulag camp in 50 km	Gulag camp in 20 km
Indep. variable	(1)	(2)
Treatment	0.154**	0.255**
	(0.051)	(0.064)
Treatment ×		
1926-1939	**0.170****	**0.145***
	(0.070)	(0.089)
1939-1959	**0.031**	**-0.053**
	(0.059)	(0.075)
1959-1970	-0.195**	-0.265**
	(0.052)	(0.065)
1970-1979	-0.148**	-0.250**
	(0.052)	(0.065)
1979-1989	-0.167**	-0.246**
	(0.051)	(0.064)
1989-2002	-0.204**	-0.308**
	(0.051)	(0.064)
2002-2010	-0.121**	-0.219**
	(0.050)	(0.063)
Year effects	yes	yes
Years	1987-2010	1987-2010
Number of obs	5636	5636
Errors clustered on	city	city
Number of clusters	763	763
R-sq overall	0.36	0.36

Robust SE in parentheses, ** - significant at 95% level, * - at 10% level.

Table 5: Gulag camps and city growth, panel estimations.

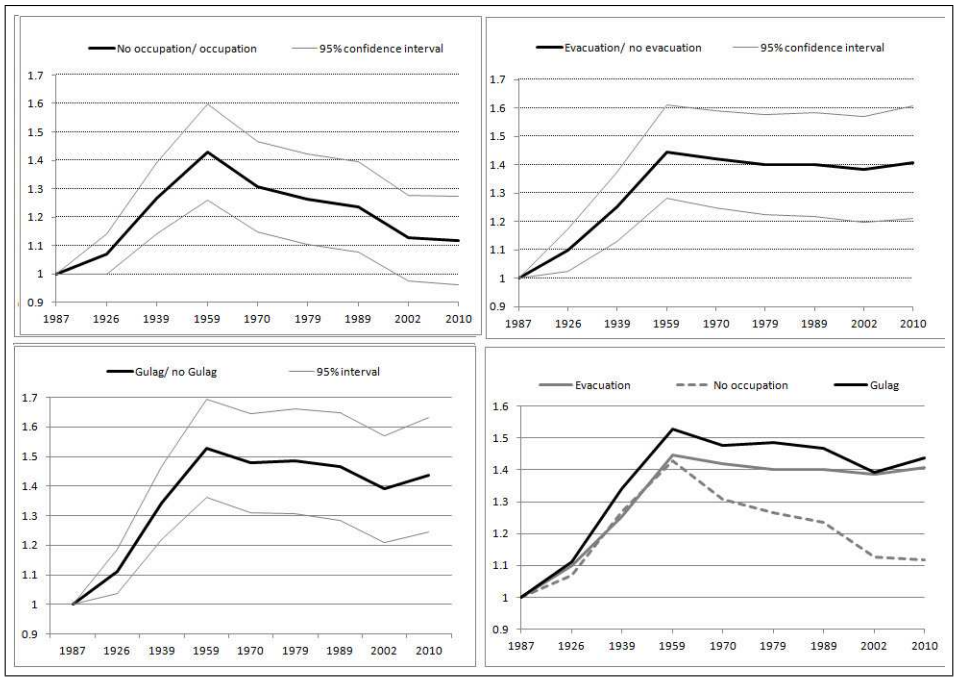


Figure 8: City size index, as implied by separate panel estimations with city effects.

where to invest in infrastructure, drove both Gulag camp allocation and evacuations.These decisions also are correlated with the distance from the western border, and therefore with being close to the WWII front lines. There is no guarantee that random effects would be able to isolate the effects of war from the effect of Gulag, for example. To try to do so, I estimate a panel model with all three treatments included simultaneously. Table 6 and Figure 9 present the results.

The conclusions about the effects of the front lines and Gulag camps remain the same. The trajectory of a city-size index for the evacuation destinations changes though: there is no more visible structural break in 1959, and no weak mean-reversion after 1959. However, the changes in the trajectory are small compared to the span of the 95% confidence bound.

Examining the random effects for "randomness" gives some insight into how well the unobserved city characteristics are controlled for, using the panel structure of the data. In fact, the random effects generated by the single-panel model (from Table 6) are strongly correlated with the geographical longitude (43% correlation) and the administrative status

Treatment	Occupied	Received evacuation	Gulag in 50 km
Treatment	-0.041	0.090	0.129**
	(0.051)	(0.057)	(0.052)
Treatment×			
1926-1939	-0.161**	-0.005	**0.142****
	(0.069)	(0.080)	(0.069)
1939-1959	**-0.054**	**0.049**	**0.013**
	(0.059)	(0.067)	(0.061)
1959-1970	0.141**	-0.070	-0.154**
	(0.054)	(0.059)	(0.054)
1970-1979	0.078	-0.095*	-0.116
	(0.053)	(0.058)	(0.053)
1979-1989	0.064	-0.079	-0.140**
	(0.053)	(0.058)	(0.052)
1989-2002	0.122**	-0.062	-0.169**
	(0.053)	(0.057)	(0.052)
2002-1010	0.059	-0.075	-0.096*
	(0.051)	(0.056)	(0.051)
Year effects	yes		
Years	1897-2010		
Number of obs	5636		
Errors clustered on	city		
Number of clusters	763		
R-sq overall	0.38		

Dependent variable is an annualized growth rate of a city between two census years, in %. Robust SE in parentheses, ** - significant at 95% level, * - at 10% level.

Table 6: Panel model with three treatment variables.

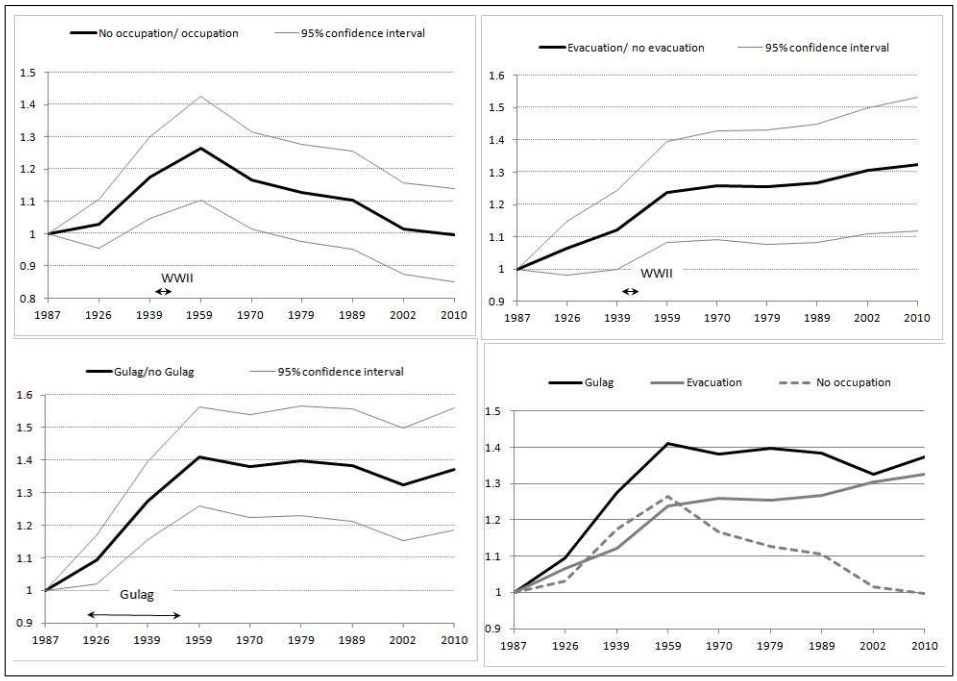


Figure 9: City size index, as implied by a single panel model with city effects.

of a city (49% correlation), i.e. they are not actually random. To illustrate, Figure 10 plots the estimated random effects against geographical longitude.

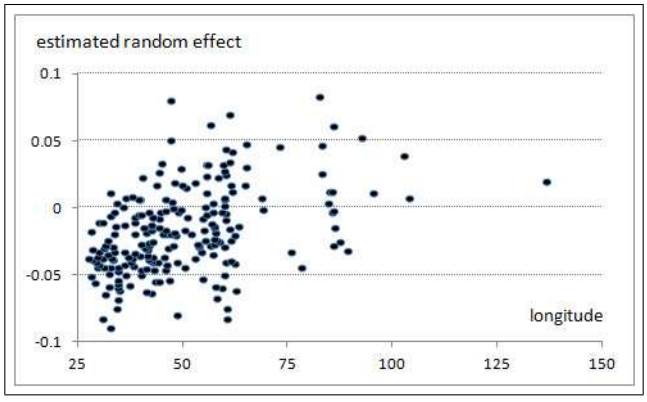


Figure 10: Estimated city-level random effects and geographical longitude.

Arguably, the positive association between faster growth of a city and its administrative status does not necessarily present a problem. It might be the result of circular causality: the best locations become large cities and administrative centers throughout the course of history, and maybe these cities should have a large unobserved growth component, even in the absence

of Soviet policy. But a positive correlation with longitude is very nonintuitive. Eastern parts of Russia are famous for their cold climate, low population density, and remoteness. Large positive random effects for the majority of the eastern cities are unlikely to be the result of unobserved attractiveness of their locations; most likely they are the result of a general eastward bias in the Soviet location policy. That is, panel estimates are unable to distinguish between locations inherently attractive and locations favored by the Soviet policy.

In the next section, I employ an alternative approach. Instead of controlling for city heterogeneity with random effects, I explicitly control for the observable characteristics of a city. Among the control characteristics are geographical location, administrative status, past population level, and growth rate.

6 Matching Estimations

I analyze long-run trajectories of city growth using Abadie & Imbens (2002) bias-corrected matching estimator of average treatment effects for all three groups of factors: location relative to WWII front, industry evacuation, and Gulag. The choice of matching technique versus regression analysis allows me to remain agnostic about the functional form of the relationship between control variables and city growth. In principle, this relationship can be very unorthodox. The most obvious example of this is that the relationship between geographical variables and city growth does not have to be linear, or even have a simple functional form. Without a theory to guide the choice of a functional form, and with a large sample, matching estimators are a logical choice.

For each treated city, one or several matches from the control group are found. Matching cities must be as similar as possible to the treated city, with the similarity defined over the set of chosen characteristics. Then, the differences between treatment group and matching control group are analyzed in order to determine the effect of treatment.

To properly assess the effects of war, evacuation, or Gulag, we must compare cities of

similar administrative status and geographical location. As panel estimations show, the cities affected by WWII were different from the control group, even before the war. Therefore, I must also control for prior city growth and size. In all of the regressions, I exactly match cities on *oblast* center status. That is, I compare *oblast* centers with other *oblast* centers, and ordinary cities with other ordinary cities. *Oblast* centers may be more attractive than the average city because of their administrative functions.[12]

Cities also are matched on latitude, longitude, initial population level, and the rate of growth in the preceding time period. The algorithm looks for the closest matches in this four-dimensional space of matching characteristics (standardized by the sample variance), where the metric is given by the Euclidian distance (for details, see Abadie, Drukker, Herr & Imbens (2001)).

Finally, for each of the treatments, the cities are matched exactly on other treatments. For example, the growth of cities on both sides of WWII front lines is compared for those with the same evacuation status (whether enterprises were evacuated from the city, or to the city) and controlling for having a Gulag camp nearby. In the same way, cities that received evacuated plants are compared to cities that also were unaffected by WWII fighting, and to cities with the same Gulag status (presence or absence of a camp in the vicinity).

Table 7 presents the results for the WWII treatments. The effect of occupation is negative in 1939-1959 (as expected), but by 1970 the recovery is complete. There is no evidence that being occupied has any effect on city growth 25 years after the end of the war. This is in line with the results by Davis & Weinstein (2002), who found a similarly complete recovery from wartime destruction for Japanese cities.

[12]Another potentially important factor for the city growth are restrictions on residential mobility in the USSR. I borrow the data on residential restrictions (total and expansion restrictions) from Gang & Stuart (1999). Total restrictions were meant to prohibit all in-migration except for the cases of family reunion. Expansion restrictions set targets for new labor from outside of a city that can be attracted by resident enterprises, and supposedly presented a weaker barrier for city growth. I tried matching cities on mobility restrictions, but the quality of matching is poor (not too many cities in the sample were restricted, it is difficult to find a match in the geographical vicinity). Yet the results with this control and without it were practically the same, which is an indirect confirmation of their result: administrative restrictions did not have a significant impact on city growth. I do not report these estimates in the paper.

Dependent variable is $LnPop_t - LnPop_{t-1}$

Treatment variable	(1) Occupied	(2) 30 km to front	(3) 200 km to front	# of obs
Time period				
1939-1959	-0.071** (0.030)	-0.074** (0.030)	-0.135** (0.034)	624
1939-1970	-0.012 (0.036)	0.003 (0.037)	-0.063 (0.044)	625
1939-1979	0.038 (0.042)	0.040 (0.042)	-0.062 (0.051)	625
1939-1989	0.029 (0.047)	0.023 (0.048)	-0.070 (0.059)	629
1939-2002	0.074 (0.051)	0.013 (0.057)	-0.069 (0.065)	629
1939-2010	0.075 (0.052)	0.018 (0.062)	-0.068 (0.069)	627
% of obs treated	32	43	59	
% of exact matches	84	86	85	
Matching variables	latitude, population 1939, growth 1926-1939,	latitude, population 1939, growth 1926-1939,	latitude, population 1939, growth 1926-1939,	
exact matching on	oblast center status, evacuation (to, from), Gulag in 50 km.	oblast center status, evacuation (to, from), Gulag in 50 km.	oblast center status, evacuation(to, from), Gulag in 50 km.	

Number of matches - 3, estimators are bias-adjusted for non-exact matching. Standard errors are heteroskedasticity- robust, ** denotes significance at 95% level, * - at 90% level.

Table 7: WWII and city growth, matching estimations.

As for evacuation status (Table 8), positive effects are observed for cities that received evacuation, but the effect is not statistically significant beyond 1970. Interestingly, the coefficient for treatment effect does not diminish over time, but its variance grows significantly. Perhaps to fully explore the heterogeneity in the impact of evacuation, the researchers would need to collect more detailed archival data on the number of evacuees, size, or specialization of the enterprises evacuated.

Restricting matching destination-cities to the cities in the same macro-region does not change the results (column (2)). Cities, where industrial establishments did not return after the war, grew slower than the average until 1959, but the effect is short-lived and disappears in 1970 and later (column (5)).

As in the panel estimations, the positive and long-lasting effects for cities that sent plants into evacuation (column (3)) are due to the same statistical artifact of Soviet regional priorities and selection. When the matching algorithm places too much weight on geographical proximity, I end up pairing industrial cities in central Russia, where enterprises were evacuated from, with cities in the same region where there was no important industry. When I do not match by longitude, this effect disappears (column (4)).

In contrast, the presence of a Gulag camp has a long-lasting and positive impact on city growth (table 9, column (1)). The difference between treatment and control group does not diminish, it actually continues to grow, even up to the present time! City size indices for all three treatments are plotted on Figure 11.[13]

In columns (2)-(5), of Table 9, I report the estimates of the treatment effects for different types of Gulag camps. Camps that specialized in agriculture/forestry (most of these were logging operations, where prisoners worked) or construction had relatively weaker effect on cities. In "agriculture/forestry" camps, prisoners were used mainly to extract valuable resource (timber), not to create infrastructure for future development. Among the "con-

[13]Using "Gulag in 20 km" indicator produces even stronger results. As a robustness check, for the war and evacuation treatments I also did matching on the prior growth and size of city in 1926 (to have the same matching set as for Gulag treatment), the results are essentially the same. I do not report these results in the paper, but they are available upon request.

Dependent variable is $LnPop_t - LnPop_{t-1}$

Treatment variable	(1) enterprises evacuated to	(2) enterprises evacuated to	(3) enterprises evacuated from	(4) enterprises evacuated from	(5) enterprises did not return	# of obs
Time period						
1939-1959	0.109**	0.109**	0.378**	-0.063*	-0.106**	624
	(0.036)	(0.0367)	(0.037)	(0.038)	(0.047)	
1939-1970	0.120*	0.120*	0.262**	-0.005	-0.051	625
	(0.062)	(0.062)	(0.041)	(0.043)	(0.055)	
1939-1979	0.114	0.113	0.188**	0.004	-0.056	625
	(0.073)	(0.073)	(0.044)	(0.046)	(0.060)	
1939-1989	0.122	0.120	0.246**	-0.013	-0.041	629
	(0.082)	(0.082)	(0.049)	(0.050)	(0.073)	
1939-2002	0.117	0.117	0.173**	-0.025	-0.041	629
	(0.084)	(0.084)	(0.051)	(0.053)	(0.72)	
1939-2010	0.101	0.099	0.137**	0.021	-0.038	627
	(0.085)	(0.085)	(0.052)	(0.101)	(0.068)	
% of obs treated	25	25	16	16	8	
% of exact matches	99	62	63	63	63	
Matching variables	latitude, longitude, population 1939, growth 1926-1939,	latitude, longitude, population 1939, growth 1926-1939,	latitude, longitude, population 1939, growth 1926-1939,	latitude, population 1939, growth 1926-1939,	latitude, population 1939, growth 1926-1939,	
exact matching on	oblast center status, war front in 200 km, Gulag in 50 km.	oblast center status, war front in 200 km, Gulag in 50 km, Urals, Siberia.	oblast center status, war front in 200 km, Gulag in 50 km.	oblast center status, war front in 200 km, Gulag in 50 km, longitude.	oblast center status, war front in 200 km, Gulag in 50 km, longitude.	

Number of matches - 3, estimators are bias-adjusted for non-exact matching. Standard errors are heteroskedasticity- robust, ** denotes significance at 95% level, * - at 90% level.

Table 8: Wartime enterprise evacuation and city growth, matching estimations.

Dependent variable is $LnPop_t - LnPop_{t-1}$

	Gulag camp in 50 km					
Treatment variable	(1) all camps	(2) resource extraction	(3) industry	(4) agriculture and forestry	(5) construction	# of obs
Time period						
1926-1939	0.104**	0.126*	0.223**	0.134**	0.097**	459
	(0.046)	(0.076)	(0.061)	(0.057)	(0.048)	
1939-1959	0.076**	0.218**	0.161**	0.060	0.090**	458
	(0.031)	(0.053)	(0.033)	(0.048)	(0.031)	
1926-1959	0.177**	0.323**	0.381**	0.190**	0.185**	458
	(0.061)	(0.094)	(0.074)	(0.085)	(0.062)	
1926-1970	0.176**	0.279**	0.387**	0.162*	0.200**	458
	(0.073)	(0.085)	(0.088)	(0.085)	(0.073)	
1926-1979	0.198**	0.321**	0.416**	0.195**	0.224**	458
	(0.082)	(0.093)	(0.099)	(0.089)	(0.084)	
1926-1989	0.222**	0.381**	0.422**	0.213**	0.216**	459
	(0.088)	(0.089)	(0.104)	(0.092)	(0.095)	
1926-2002	0.217**	0.355*	0.412**	0.214**	0.215**	459
	(0.091)	(0.096)	(0.109)	(0.094)	(0.095)	
1926-2010	0.226**	0.398**	0.455**	0.273**	0.231**	458
	(0.093)	(0.095)	(0.111)	(0.099)	(0.098)	
% of obs treated	46	18	24	13	34	
% of exact matches	97	91	95	93	97	
Matching variables	latitude, longitude population 1926, growth 1897-1926,	latitude, longitude population 1926, growth 1897-1926,	latitude, longitude population 1926, growth 1897-1926,	latitude, longitude population 1926, growth 1897-1926,	latitude, longitude population 1926, growth 1897-1926,	
exact matching on	oblast center status, evacuation (to, from), war front in 30 km	oblast center status, evacuation (to, from), war front in 30 km	oblast center status, evacuation (to, from), war front in 30 km	oblast center status, evacuation (to, from), war front in 30 km	oblast center status, evacuation (to, from), war front in 30 km	

Number of matches - 3, estimators are bias-adjusted for non-exact matching. Standard errors are heteroskedasticity- robust, ** denotes significance at 95% level, * - at 90% level.

Table 9: Gulag and city growth, matching estimations.

struction" camps were those created for the infamous infrastructural projects of the 1930s: Northern Railroad, White-Sea-Baltic canal. Some of these projects proved a failure and were abandoned.

On the other hand, camps that specialized in industrial production (either primary industries or other manufacturing) were creating this coveted "eastern industrial base" of the Soviet Union. Their impact on city size is twice as strong as that of an average camp.

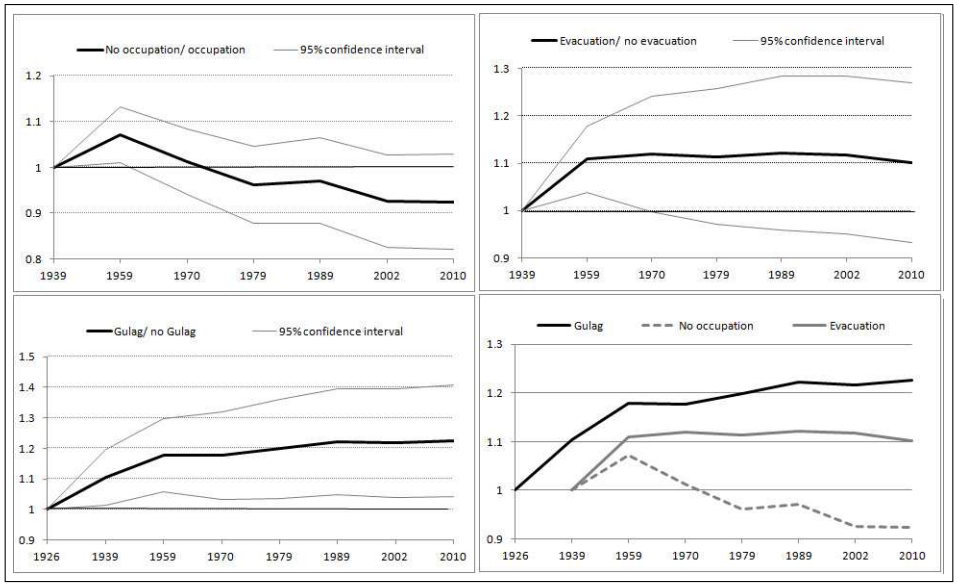


Figure 11: City size index, as implied by matching estimations.

Table 10 presents estimated treatment effects for the different types of construction in Gulag. Consistent with Table 9, construction of industrial objects and housing leads to stronger long-run population increases. Construction of infrastructure shows weaker effects.

7 Conclusion

It is well understood that Gulag made possible many investment projects in the far corners of the USSR. I show that it also brought significant and long lasting changes to the spatial economy of the Soviet Union. Its impact worked on both the interregional and the intra-regional scale.

Dependent variable is $LnPop_t - LnPop_{t-1}$

	Gulag camp in 50 km				
Treatment variable	(1) industrial construction (primary)	(2) industrial construction (manufacturing)	(3) housing construction	(4) infrastructure construction	# of obs
Time period					
1926-1939	0.206**	0.097*	0.160**	0.105**	459
	(0.062)	(0.056)	(0.067)	(0.049)	
1939-1959	0.248**	0.141**	0.146**	0.082**	458
	(0.065)	(0.036)	(0.041)	(0.031)	
1926-1959	0.460**	0.236**	0.302**	0.184**	458
	(0.093)	(0.072)	(0.086)	(0.063)	
1926-1970	0.399**	0.227*	0.290**	0.212**	458
	(0.094)	(0.079)	(0.094)	(0.076)	
1926-1979	0.412**	0.255**	0.318**	0.243**	458
	(0.109)	(0.087)	(0.102)	(0.087)	
1926-1989	0.393**	0.274**	0.333**	0.232**	459
	(0.108)	(0.092)	(0.106)	(0.095)	
1926-2002	0.389**	0.282**	0.336**	0.226**	459
	(0.115)	(0.096)	(0.109)	(0.097)	
1926-2010	0.443**	0.337**	0.392**	0.241***	458
	(0.120)	(0.100)	(0.117)	(0.101)	
% of obs treated	11	17	21	31	
% of exact matches	90	95	94	97	
Matching variables	latitude, longitude population 1926, growth 1897-1926,	latitude, longitude population 1926, growth 1897-1926,	latitude, longitude population 1926, growth 1897-1926,	latitude, longitude population 1926, growth 1897-1926,	
exact matching on	oblast center status, evacuation (to, from), war front in 30 km	oblast center status, evacuation (to, from), war front in 30 km	oblast center status, evacuation (to, from), war front in 30 km	oblast center status, evacuation (to, from), war front in 30 km	

Number of matches - 3, estimators are bias-adjusted for non-exact matching. Standard errors are heteroskedasticity- robust, ** denotes significance at 95% level, * - at 90% level.

Table 10: Construction by Gulag prisoners and city growth, matching estimations.

To what extent was Gulag responsible for the reallocation of productive resources toward the remote regions of the USSR? Millions of people went through the Gulag system, but compared to the Soviet population, the size of Gulag labor force does not not seem economically significant. Even at its maximum, the able-bodied population of Gulag did not exceed 2% of the Soviet labor force (Khlevnyuk (2004)). A vast majority of Gulag camps were located close to population centers, where the size of the local labor force significantly exceeded the size of the camp population. But the presence of a camp is a good indicator of a local deficit of labor. Gulag was not the only tool of Soviet regional industrial policy, but its presence is a good signal that the location was chosen by the Soviet authorities for investment projects. What we observe in the data is probably not the effect of Gulag *per se*, but rather the combined effect of Soviet location policy for which Gulag is a good proxy.

Gulag camps were heterogeneous. Some of the camp locations were oriented exclusively toward resource extraction, were not planned as permanent settlements, and quickly withered after Stalin's death. We know examples of abandoned camps in the middle of empty frozen landscapes. But the camps that were located close to the existing population centers were used to build basic industrial and public infrastructure, and to supply labor for industrial facilities, a part of long-term regional planning strategies. Such locations continue to attract population even after the Gulag system (and prison labor in general) has stopped functioning as a source of slave labor.

The effect of Gulag is much stronger than the estimated effects of WWII or reallocation of wartime industry. WWII is an example of exogenous impact, although Soviet authorities partially relocated productive resources away from the western border in preparation for it. Evacuation was designed by the Soviet authorities, but it was done under the pressure of the Nazi invasion and thus should have served the purpose of maximizing Soviet industrial potential in wartime, i.e. in the short run. In contrast, Gulag was a part of long-run Soviet location policy, it was deliberately planned, and it served long-term goals. The changes to the Soviet spatial economy landscape in the 1930s to 1950s proxied by Gulag were perceived

as (and indeed were) permanent. My findings provide yet another illustration of "successful" regional policy. It a strong suggestion that to be able to change economic geography in the long run, the impact of regional policy has to be as significant as Stalin's industrialization of the eastern USSR.

The strongest long-term effect found here is for Gulag camps that specialized in industry, industrial construction, and construction of housing. What are the mechanisms behind this? Do Stalin-era investments in capital and infrastructure still make the cities attractive, or are there other history-dependent factors? Is there a difference in local industrial structure between cities with Gulag camps and cities without them? What about sectoral diversity and specialization? Is there a difference in human capital? I leave these questions for further research.

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