# Middleman Minorities and Ethnic Violence: Anti-Jewish Pogroms in the Russian Empire*

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**Abstract**

We present evidence to reconcile two seemingly contradictory observations: on the one hand, minorities often choose middleman occupations, such as traders and moneylenders, to avoid competition with the majority and, as a consequence, avoid conflict; on the other hand, middleman minorities do become the primary target of persecution. Using panel data on anti-Jewish pogroms in Eastern Europe between 1800 and 1927, we document that ethnic violence broke out when crop failures coincided with political turmoil. Crop failures without political turmoil did not cause pogroms. At the intersection of economic and political shocks, pogroms occurred in places where Jews dominated moneylending and trade in grain. This evidence is consistent with the following mechanism. When political situation was stable, negative economic shocks did not instigate pogroms because the majority valued future services of Jewish middlemen. In contrast, in times of a sharp increase in political uncertainty, Jewish middlemen became the primary target of mob violence following an economic shock as the value of their future services fell. Peasants organized pogroms when they could not repay loans to Jewish creditors and buyers of grain turned against Jews blaming Jewish traders for an increase in grain prices.

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# 1 Introduction

Minorities often engage in middleman occupations, such as traders and financiers. Examples abound both across the world and throughout history: Chinese in Philippines and Indonesia, Ibos in Nigeria, Marwaris in Burma, Lebanese in Sierra Leone, Muslims in India, Greeks and Armenians in the Ottoman Empire, and Jews in Medieval Western and Modern Eastern Europe (Bonacich, 1973; Chua, 2004; Sowell, 2005). At least since Horowitz (1985, pp.108-121), it has been argued that ethnic minorities with occupations complementary to those of the majority may avoid conflict by not engaging in direct competition with the majority. A number of studies recently provided systematic evidence in support of this conjecture in different contexts. For example, Muslim traders avoided violence in Ports of South Asia because of their economic value to the Hindu majority (Jha, 2013, 2014); towns where Jews provided moneylending and trading services to the majority were spared during the wave of anti-Jewish violence following the outbreak of Black Death in Western Europe (Jedwab, Johnson and Koyama, 2017). Several authors take this observation one step further by arguing that minorities' middleman occupations may be a result of an endogenous choice to avoid competition with the majority and, thus, conflict. This may happen both as a result of self-segregation or restrictions imposed by the majority, especially when majority choses to avoid middleman occupations due to cultural preference or comparative advantage (Bonacich, 1972; Horowitz, 1985; Jha, 2016).

Middleman minorities, however, do become the primary target of ethnic violence (Bonacich, 1973). Furthermore, Chua (2004) and Sowell (2005) argue that middlemen are prosecuted because of the very nature of their occupations: middlemen-hatred in the eyes of a "productive" majority is associated with "parasitism" and "exploitation." This raises a puzzle of how one could reconcile a certain level of ethnic violence against middleman minorities with the equilibrium choice of middleman occupations as a safeguard against violence. To solve this puzzle one needs to study the conditions under which violence against middleman minorities breaks out. Becker and Pascali (2016) make a step toward solving this puzzle by showing that the Protestant Reformation led to a spread of anti-Semitic violence in the Protestant parts of Germany leaving Jews in the Catholic parts of Germany in a relative peace. They provide evidence that this violence was caused by an increase in inter-ethnic competition in the credit sector explained by a shift in the culture of the majority leading to their expansion into moneylending, traditionally dominated by Jews. However, many episodes of violence against middleman minorities occurred without any major cultural revolutions or changes in occupations of the majority.

In this paper, we examine the determinants of the outbreaks of anti-Jewish mob violence in the 19th and early 20th century Eastern Europe. Due to these historical events the word "*pogrom*" entered European languages. Pogroms were directed against the middleman minority as Jews in Eastern Europe dominated market intermediary occupations, such as traders and moneylenders (e.g., Slezkine, 2004; Grosfeld, Rodnyansky and Zhuravskaya, 2013) and occurred at times of no major cultural change.

We combine data on anti-Jewish pogroms, seasonal agro-climatic shocks as a proxy for agricultural income, grain yields and prices, occupations and education levels by ethnic group, and the periods of political turmoil to examine the determinants of pogroms in the Pale of Jewish Settlement, a vast area in the Russian Empire where Jews were allowed to live. Our unit of analysis is a geographic grid cell of $0.5 \times 0.5$ degree in a year between 1800 and 1927, one year before the start of Soviet mass collectivization. Figure 1 illustrates the geographic area under study and the unit of analysis and presents the map of localities of pogroms throughout the Pale of Settlement. Our empirical approach is to estimate a linear probability model with difference-in-differences OLS and IV regressions, in which the probability of pogroms in a grid cell in a year is a function of economic and political shocks and the occupational choices of Jews relative to those of the majority, controlling for grid cell and year fixed effects and adjusting the standard errors for both spatial and over-time correlations.

As a starting point, we show that agro-climatic shocks were on average associated with pogroms in line with findings of the previous literature (see Anderson, Johnson and Koyama (2016) in the context of anti-Jewish violence in the Middle Ages and, e.g., Miguel (2005), Burke et al. (2009), and Harari and Ferrara (2012) in other contexts). However, we document that this relationship masks two important sources of heterogeneity, which is our main contribution. First, pogroms occurred at times when the negative agro-climatic shocks intertwined with episodes of an unprecedented increase in political uncertainty about the future (henceforth referred to as political turmoil). Second, pogroms primarily affected localities where Jews dominated middleman occupations, in particular, moneylenders and traders, as opposed to artisans or other occupations.

Figure 2 illustrates the importance of the intersection of political turmoil with crop failures for pogrom occurrence. It presents the number of pogroms over time in Panel A, and then, overlays this time series with the times of crop failures (proxied by agro-climatic shocks) in Panel B, with the periods of political turmoil in Panel C, and with the periods when crop failures coincided with the episodes of political turmoil in Panel D. We describe the definition of political turmoil and agro-climatic shocks below. The vast majority of pogroms came in three waves, which was well noted by Jewish historians (e.g., Klier and Lambroza, 1992*b*). Figure 2 shows that pogrom waves occurred every time when crop failures in some areas within the Pale of

Settlement coincided with political turmoil. Several episodes of extremely bad harvests and of political turmoil took place before the first wave of pogroms and several crop failures, including the largest famine in the Russian Empire of 1891, occurred between pogrom waves. Neither agro-climatic shocks without political turmoil, nor political turmoil without crop failures caused ethnic violence. Our estimates imply that, at times of increased political uncertainty, a severe negative agro-climatic shock increased the probability of pogrom occurrence in an average grid cell by 3.8 percentage points from the mean level of 0.5%, i.e., by 54% of the standard deviation of pogrom occurrence, and had a zero effect on the likelihood of pogroms in times of a relative political peace. Importantly, during the first two waves of pogroms, the state had full capacity to punish pogrom perpetrators. Only in the last wave of pogroms, political turmoil meant both the increase in uncertainty about the future and the collapse of state institutions, and particularly, law enforcement. During that wave, ethnic violence was exacerbated by the collapse of the state in the midst of the Civil War.

Figure 3 illustrates the second key driver of pogroms, i.e., the Jewish domination over the middleman occupations: the local credit sector and the trade in grain. Panel A of the figure shows that the frequency of pogrom occurrence in a grid cell that suffered from a negative agro-climatic shock at times of political turmoil was much higher in localities where Jews constituted the majority of moneylenders. In the empirical analysis, we establish the robustness of this correlation to controlling for a large number of potential confounds and adjusting standard errors for spatial correlation. Furthermore, to establish causality, we rely on the argument presented by Botticini and Eckstein (2012) about the advantage of Jews in moneylending coming from their relatively high levels of literacy due to their religious tradition of reading spiritual texts formed at the end of the second century. We instrument the share of Jews in moneylending with the difference between literacy rates among Jews and non-Jews controlling for the overall literacy rate and the shares of Jews in other occupations that require literacy. This literacy gap is a strong predictor of the share of Jews among creditors. Our IV estimates imply that during a severe local agro-climatic shock coupled with political turmoil, the probability of a pogrom was 7.4% in grid cells, where the share of Jews among moneylenders was one SD above the mean; and it was 0.7% in grid cells, where the share of Jews among creditors was one SD below the mean.[1]

Grain prices in the Pale were affected by agro-climatic shocks occurring in the most suitable areas for grain cultivation. Panel B of Figure 3 shows that at the intersection of political turmoil with times when crop failures occurred in these areas, pogroms were more frequent in localities where the share of Jews among traders in grain was above

[1]The mean value of the share of Jews among creditors was 53.8% with standard deviation of 28.4 percentage points; and the mean probability of a pogrom in a grid cell in an average year was 0.5%.

85% (which was the case in three quarter of all grid cells) compared to localities where the share of Jews among traders in grain was below 85% (one fourth of grid cells). In the empirical analysis, we show that this correlation is also robust to including covariates for potential confounds, adjusting standard errors for spatial correlation, and using the number of Jewish traders in grain, rather than their share. We show that pogroms in localities, where the Jews dominated trade in grain, took place as a result of price increases: the number of Jewish traders in grain was an important determinant of pogroms when grain prices increased during political turmoil. If we consider grid cells with an average share of Jews among moneylenders, during a global crop failure and a political shock, the probability of a pogrom was 7.4% percent in grid cells, where the share of Jews among traders in grain was one SD above the mean; and it was 4.9% percent in grid cells, where the share of Jews in the credit sector was one SD below the mean.[2]

We interpret this evidence as follows. When political situation was stable, occupational segregation along ethnic lines, which was present everywhere in the Pale of Settlement, did help avoiding conflict during economic crises.[3] Majority did not expropriate Jews during severe economic shocks outside the times of political turmoil despite the possible short-term economic gain of doing so because the majority valued the future services of Jews as middlemen. In contrast, during the times of extreme political uncertainty, such as following the assassination of Alexander II, the Tsar-Liberator, when peasants thought serfdom would be reinstalled by the new Tsar, or during the Russian revolutions, the continuation value of a relationship with the middlemen dropped as majority did not see the future. In those times, economic shocks resulted in violence against the Jews.[4] When economic and political crises coincided, the middleman nature of the traditional occupations of the Jewish minority made them more vulnerable to persecution. The Jewish creditors became the primary target of violence when peasants could not repay their debts and did not find it worthwhile to renegotiate or refinance due to the extreme uncertainty about the future.[5] Similarly, buyers of grain turned against the Jews because they blamed Jewish traders for price increases during crop failures if the future was too uncertain to value the continuation of the relationship with the middlemen. Overall, we conclude that middleman occupations, including specialization in moneylending and grain trade, were an optimal

[2]The mean value of the share of Jews among traders in grain was 87.9% with standard deviation of 18.4 percentage points.

[3]This finding contrasts with the traditional "scapegoat" theory, according to which Jews were blamed for all economic misfortunes and political crises (e.g., Girard, 1986; Glick, 2008).

[4]This argument resonates with the theory presented by Esteban, Morelli and Rohner (2015), who model the net present value of mass killing for the perpetrator.

[5]As a rule, peasants got loans during the planting season and had to repay after the harvest was sold.

choice for Jews *ex ante* as neither the Jews, nor the majority could have anticipated the unprecedented level of political instability which materialized in Russia at the end of the nineteenth century and the beginning of the twentieth century and which lead to a breakdown of the peaceful and beneficial coexistence between non-Jewish majority and Jewish middleman minority.

We provide evidence against a number of alternative explanations to our findings. In particular, we argue that the change in the probability of punishment of perpetrators as a result of political shocks, the change in relative incomes of ethnic groups as a result of income shocks, and the changes in the level of general crime cannot explain our results.

Our politico-economic explanation of pogroms does not mean that we question the prevalence of anti-Semitism among non-Jews in the Pale of Settlement. Anti-Jewish attitudes were transferred from one generation to the next through family upbringing in the Pale (e.g., Grosfeld, Rodnyansky and Zhuravskaya, 2013) as much as in other parts of Europe (e.g., Voigtländer and Voth, 2012). Many of the pogroms in each waves were justified by the perpetrators with belief of *blood libel* (e.g., Klier and Lambroza, 1992*a*). Our results highlight the economic and political factors that lead to outbursts of violence in the face of inherent religious and ethnic animosity.

Historians also have noticed extraordinary combination of economic and political crises that led to violence against Jews and particularly violence against Jewish moneylenders. Rogger (1992*a*) argues that violence against Jewish creditors in Germany, Austria, and French Alsace was brought about by political turmoil of the 1848 revolutions in combination with harvest failures of 1845 and 1846 (p.314). Aronson (1990) describes the factors that triggered the first wave of pogroms in the Russian Empire: *"Exceptional circumstances existed in 1881.[] Unknown tsar had scended the throne in the wake of the violent assassination of the "Tsar liberator," and the peasants were uncertain [about their future]. The weather was unseasonably hot.[] During 1880 and 1881 local crop failures had brought on near famine conditions in some areas"* (p.122). Lambroza (1992) writes about the second wave of pogroms in the Russian Empire: *"Poor harvest in 1902-1903 caused wide-scale violent unrest in rural areas.[] Political conditions were worsened by the disastrous Russo-Japanese War of 1904 and the massacre of innocents at the Winter Palace in January 1905"* (p.195). The occurrence of group violence at the intersection of negative economic and political shocks is not specific to anti-Jewish violence. For example, witch trials in New England in the 17th century also took place when economic and political crises coincided (Boyer and Nissenbaum, 1974).

We contribute in two ways to the vast literature on economic, political, institutional, and climatic determinants of ethnic conflict, reviewed by Blattman and Miguel

(2010), Jackson and Morelli (2011), and Burke, Hsiang and Miguel (2015); see also Caselli and Coleman (2013), Mitra and Ray (2014), and Esteban, Morelli and Rohner (2015). First, we highlight the importance of political uncertainty as a factor that links economic shocks to ethnic violence. Second, we document that occupational segregation across ethnic groups can both prevent and catalyse violence depending on the economic and political conditions. Economic specialization helps avoiding intergroup conflict during economic crises in times of a relative political stability and triggers conflict when economic crisis is intertwined with extreme political uncertainty. Our results help to reconcile two seemingly contradictory literatures: on the one hand, economists (e.g., Jha, 2007, 2013, 2016; Jedwab, Johnson and Koyama, 2017) stress the positive role of economic complementarity of ethnic groups for peaceful coexistence; on the other hand, sociological literature (e.g., Bonacich, 1973; Chua, 2004; Sowell, 2005) and historical literature (e.g., Dubnow, 1920; Slezkine, 2004) document the episodes of violence against ethnic minorities segregated along the occupational lines. Becker and Pascali (2016) document that a major cultural change was the mechanism through which Jewish moneylenders became the target of ethnic violence in Western Europe.

Our work is also related to the literatures on the economic role played by Jews historically (e.g., Botticini and Eckstein, 2012; Johnson and Koyama, 2017; Spitzer, 2015*a*) and in the long run through the persistence of cultural values (e.g., Voigtländer and Voth, 2012; Pascali, 2016; Grosfeld, Rodnyansky and Zhuravskaya, 2013). We also contribute to the literatures on the economic and political origins of the prosecution of Jews (e.g., Allport, 1954; Arendt, 1973) as well as on its economic and social consequences (e.g., Acemoglu, Hassan and Robinson, 2011; Akbulut-Yuksel and Yuksel, 2015; D'Acunto, Prokopczuk and Weber, 2015; Spitzer, 2015*b*).[6]

The rest of the paper is organized as follows. Section 2 provides a brief overview of the Pale of Jewish Settlement, the waves of anti-Jewish violence in the Russian Empire, and the periods of extreme political turmoil in the Russian Empire of the 19th and 20th century and the early Soviet Period. We formulate the empirical question in Section 3 and describe the data in Section 4. Section 5 discusses the estimation strategy. Section 6 presents the results. Potential alternative mechanisms are described in Section 7. Section 8 presents the conclusions.

[6] Sakalli (2017) and Arbatli and Gokmen (2016) study the consequences of persecution of other middleman minorities.

# 2 Historical Background

## 2.1 Jews in the Russian Empire

The Russian Empire acquired the largest Jewish community in the world by annexing the territories of the Polish–Lithuanian Commonwealth during the Partitions of Poland (1772–1795); the borders were redrawn and finalized by the Congress of Vienna in 1815. Jews faced restrictions both in spatial mobility and occupational choices since their incorporation into the Russian Empire. They were confined to an area known as the Pale of Jewish Settlement and had the legal status of merchants, which prohibited them from getting involved in agriculture and owning arable land.[7] These restrictions lasted until the 1917 February revolution.

The Pale of Settlement covered a vast area in Eastern Europe, including parts of contemporary Latvia, Lithuania, Poland, Russia, and Ukraine, and the whole of contemporary Belarus and Moldova (as presented in Figure 1). According to the 1897 census, 5.2 million Jews lived in the Russian Empire, out of whom 4.8 million resided in the Pale of Settlement. Jews were a minority constituting 11.3% percent of the total Pale population and dominated market intermediary professions. In particular, Jews constituted 84% of all traders in agricultural and non-agricultural goods, 92% of all traders in grain, and 37% of all moneylenders. In addition, Jews were overrepresented in crafts and industry (45% of all employed in this sector were Jews) and in transport (30% of people employed in transport services were Jews). These professions together absorbed 11% of total Pale's employment. An agricultural worker (i.e., peasant) was the most popular occupation in the Pale. 70% of all economically active residents of the Pale were peasants. Only 0.6% of agricultural workers were Jews. Jews were present in every district—the second-tier administrative division of the Russian Empire, known as *uezd*—inside the Pale of Setlement. Yet, there was a great extent of heterogeneity across localities in the Pale both in the presence of Jews and in their occupations. Figure A1 in the online appendix presents the spatial distribution of the share of Jews in local population and among moneylenders, traders, artisans, and employed in

[7] The Pale was first instituted by several decrees starting with 1791 and subsequently by law of 1835 (see Pipes (1975) and Klier (1986) for the details of the formation of the Pale of Settlement). There were several exceptions to the Pale restrictions; "native Jews" were allowed to stay in Courland province despite it being outside the Pale. Also, in the 1820s, Jews were evicted from several cities inside the Pale, such as Kiev, Sevastopol, and Yalta. There were exceptions to the occupational restrictions as well. The "enactment concerning the Jews" of December 9, 1804, granted the Jews the right to buy and rent land in South-Western provinces of the Pale of Settlement, which led to the formation of the Jewish Agricultural Colonies in Russia. *May Laws* of 1882, however, barred Jews from settling anew in the rural areas and from owning and renting any real estate or land outside of towns and boroughs. The only exception to *May Laws* was the Jewish agricultural colonies of Kherson province.

transportation sector across grid cells in the Pale.[8] Panel A of Table 1 presents the summary statistics on the Jewish presence in local population and in different local occupations across grid cells in 1897. The average grid cell had 10.3% of Jews among all local residents (with standard deviation of 5 percentage points), 54.7% of Jews among local moneylenders (with standard deviation of 28 percentage points), and 88% of Jews among grain traders (with standard deviation of 18 percentage points).

## 2.2 Violence Against Jews

The Jews of Russia periodically became victims of ethnic violence, i.e., pogroms. Pogrom is a violent mob attack directed specifically at the Jews as ethnic and religious group, which involved physical assaults (up to murder and rape) and caused a significant damage to Jewish property. The severity of pogroms varied greatly. For example, pogrom in Balta in March 1882 resulted in 2 people killed and about 1,200 houses and shops pillaged; pogrom in Odessa in October 1905 left—according to different sources—between 300 and 1,000 dead and about 5,000 injured; pogrom in Proskurov in February 1919 left as many as 1,700 dead (Klier and Lambroza, 1992*b*). The information about historical pogroms was put together by several Jewish historians primarily from archival records of police reports and testimonies. The number of victims and the property damage was, however, not well recorded in many instances.

The first major pogrom took place in Odessa in 1821. As we illustrate in Figure 2, the vast majority of pogroms took place in three waves: 1) 1881–1882; 2) 1903–1906; and 3) 1917–1921. Historians have recognised that each of the three pogrom waves took place at the exceptional circumstances, including political and meteorological (Rogger, 1992*b*). The first wave of pogroms occurred after the assassination of Tsar Alexander II, who liberated Russia's serfs in 1861. He was assassinated by the members of a revolutionary organization, called the "People's Will" on March 13, 1881. The assassination caused extreme agitation among peasants who believed that the new tsar can reinstitute serfdom. The anti-Semitic circles spread a rumour that the tsar had been assassinated by the Jews (Aronson, 1992, p.44). The majority of the first-wave pogroms were carried out by peasants. The second wave coincided with the Russia's abysmal performance and ultimate defeat in the Russo-Japanese War and the revolutionary movement culminating in the enactment of the first Russia's constitution and the formation of the first Russia's parliament (*Duma*). Some of the second wave's large-scale pogroms were organised and carried out by the radical monarchist groups known as the "Black Hundreds," who blamed the Jews for the breakdown of social

[8] Figure A2 in the online appendix presents the spatial distribution of the size of the corresponding sectors as well as the size of agricultural employment across localities.

order and revolutionary movement. The third wave of pogroms occurred in the midst of the revolutionary agitation of the two 1917 revolutions and the subsequent Civil War. Many of the pogroms in this wave occurred in localities close to the war front and in part were carried out by peasants, in part, by the militia (Encyclopedia Judaica, 2007). Every pogrom wave took place following severe crop failure (Kenez, 1992; Lambroza, 1992; Aronson, 1992; Slezkine, 2004).

Historians argue that the Jews in the Russian Empire were often blamed for "economic exploitation" because of their middleman role in the largely agrarian society (Klier, 2011, pp.131-132). For example, Aronson (1992, p.49) stated that before the first pogrom wave "*the peasants suspected that the prices the Jews paid for agricultural produce were exceptionally low and that the interest they took on loans were exceptionally high.*" Rogger (1992*b*) also argued that food shortages and high prices for grain in times of crop failure directed the anger of peasants and burghers against the Jews because of their occupation as traders and creditors.

## 2.3 Political turmoil

Russian Empire in the 19th and the 20th centuries experienced several episodes of extreme political instability ultimately leading to the collapse of the empire and the devastating civil war. By consulting Russian economic historians, we have put together the list of episodes of extreme and unprecedented political uncertainty for our observation period (i.e., between 1800 and 1927), which we refer to as political turmoil. This list includes the most devastating wars, the assassination of Alexander II (Tsar-the-Liberator), the succession of the revolutions, and the civil war. We present the list on a historical timeline in Panel C of Figure 2. This list consists of the following historical episodes: Napoleon taking over Moscow in 1812, the defeat in the Crimean War (1855-1856), the assassination of Alexander II (1881), the revolutionary movement with a series of intense political strikes (1901-1905), the first Russia's revolution (1905), the defeat in Russo-Japanese War (1904-1905), the February and the October revolutions (1917), and the Civil War (1917-1922).

What all of these very different events had in common was the unprecedented increase in uncertainty about the future. Some of these events, but not all of them, also shared another feature, namely, they were associated with a weak state. For example, the Napoleonic invasion of Russia and the Civil War completely eliminated law enforcement from many areas inside the Pale of Settlement. In contrast, the assassination of the Tsar-the-Liberator in 1881, which, as historians argue, caused the first pogrom wave, was not associated with a change in the ability of the state to enforce law and order or with a weakening in any other aspect of state capacity. The change in the identity of the monarch was, however, politically very important. It was associated with a sharp increase in uncertainty about the future for the former serfs (e.g., Aronson, 1990), who constituted 43% of all rural Russia's residents (Bushen, 1863) and who feared that they would be forced back into serfdom. Even though serfdom was not reinstated, the assassination of Alexander II led to a substantial reduction in civil liberties and to an abandonment of the Alexander's liberalisation reforms.

Both the uncertainty about the future and the weakness of the state and, in particular, its inability to enforce law and order may affect violence against minorities (see, for instance, the arguments presented by Arendt (1973) about anti-Jewish violence in general and by Snyder (2016) about the Holocaust). As illustrated in Figure 2, each pogrom wave coincided with some episodes of political turmoil. In the last pogrom wave, political turmoil meant both the sharp increase in uncertainty and the collapse of institutions and of the state capacity to enforce order. The weakness of the state must have facilitated pogroms as the probability of punishment sharply decreased during the Civil War. Yet, since the first and the second pogrom waves were not associated with a decrease in *a priori* probability of punishment, the weakness of the state was not the main driver of pogroms. We address this point in section 7.1. It is important to note, however, that *ex post* police did not intervene to stop some of the most devastating pogroms during the first and the second wave, when the outbursts of anti-Jewish violence took a form of mass terror.

## 3 Research question

We investigate the conditions under which pogroms broke out. In particular, we examine how the economic specialization of Jews in middleman occupations interacted with the negative economic shocks, driven by crop failures, and the episodes of political turmoil in determining ethnic violence against Jews. To address this question, we compile a panel data set at a grid level of 0.5 x 0.5 degrees resolution on anti-Jewish violence and seasonal historical temperatures in the Pale of Jewish Settlement and combine it with the cross-sectional data on occupational composition across ethnic groups in 1897. Even though a number of pogroms took place to the East of the Pale border, both before and after Jews were allowed to migrate eastward, we restrict our sample to the grid cells within the Pale because the Jews constituted a much bigger share of the population in the Pale and, as a consequence, pogroms affected a much larger part of the population.

# 4 Data

## 4.1 Sources and summary statistics

In this section, we describe the data. Summary statistics of all variables used in the analysis are presented in Table 1 in the main text and Table A1 in the online appendix.

**Pogroms:** As a starting point, we use data on pogroms compiled by Grosfeld, Rodnyansky and Zhuravskaya (2013). We extend these data by adding a time dimension, i.e., by identifying the exact time of each pogrom using the historical sources. The full list of sources of data on pogroms is provided in the online appendix. As we are interested in the determinants of mob violence, following Grosfeld, Rodnyansky and Zhuravskaya (2013), we do not include in the definition of pogroms the few cases of violence against Jews known to be perpetrated solely by the police and the military without the participation of local population.

The resulting data set includes information on the locality in which each pogrom took place and the date (with few precise dates missing). We geo-referenced the locations of all pogroms and built a panel data set at a grid cell level with $0.5 \times 0.5$ degrees resolution that covers the period from 1800 to 1927. As we study ethnic violence incited by agro-climatic shocks, we stop in 1927 because this is the last year before the start of the Soviet collectivisation, which put an end to individual farming in the vast majority of our sample.

We measure violence against the Jews with a dummy variable that takes the value of 1 if a pogrom took place in a given year and grid cell, and 0 otherwise. Systematic data on the number of casualties do not exist: historians give very different estimates for the number of casualties and for the extent of property damage for many of the pogroms. Panel B of Table 1 summarizes the data on pogroms across grid cell $\times$ year observations. The probability of pogrom occurrence in a given grid cell and year is 0.51 percent, and the average number of pogroms at the grid cell-year level is 0.0084. Pogroms were more than twice as likely during the agricultural season, i.e., between April and October, than outside it, i.e., between November and March.

**Ethnicity, economic specialization, and literacy data:** To measure ethnic composition, the specialization of Jews in certain occupations, and differences in literacy of Jews and non-Jews, across localities in the Russian Empire, we digitized the detailed statistical volumes summarising the 1897 census of the Russian Empire (Troynitsky, 1899-1905). These volumes provide information for 236 districts (*uyezds*) inside the Pale of Settlement. We assign district level census data to grid cells using the following procedure: if a grid cell overlaps with only one district, we assign to this gris cell the value of the corresponding district. When several districts overlap with a given grid cell, we assign to this grid cell the average value of the census data across these districts weighted by the relative size of the areas of each district overlapping with that particular grid cell.

The census volumes report employment by occupation separately for each ethnic group in the Russian Empire; we use these data to measure occupational specialization across ethnicities. In the online appendix, we present the list of the main ethnic groups that lived in the Pale of Settlement in 1897 with their relative sizes (Table A2) and the list of the main occupations with their relative sizes in the total and in the Jewish population (Table A3).[9]

1897 census also provides information on literacy levels in Russian language and in the native language separately for each language. We use data on the overall literacy rate of local population, the literacy rate of people with Jewish native languages (i.e., Yiddish and Modern Hebrew), and the literacy rate of people with native languages other than Jewish. In the Pale of Settlement, total literacy rate was 22%, literacy rate among the Jews was 37%, and literacy rate among non-Jews was 20%. Table 1 provides summary statistics for the 1897 census variables at the grid cell level. Figures A3 and A4 in the online appendix present the histograms of the shares of Jews in local population and in various occupations as well as the correlation between them.

**Political turmoil:** To measure political uncertainty, we construct a dummy, which varies only over time and equals one during years that coincide with the episodes of political turmoil, described in section 2.3, and one year after these episodes. We treat one year following the episodes of extreme political uncertainty as political turmoil in order to account for the fact that these episodes may have lasting implications.

**Grain yields and grain prices:** The data on historical grain yields come from Markevich and Zhuravskaya (2017) and Markevich and Dower (Forthcoming). The two sources differ in terms of time coverage and aggregation level. Markevich and Zhuravskaya (2017) have collected information on grain yields at the province level (*gubernia*), i.e., the first-tier subnational administrative division of the Russian Empire, for the 19th century. In this paper, we focus on the second half of the 19th century starting with 1862 because there was a sharp change in the trend for grain yields and productivity right after the abolition of serfdom in 1861 (Markevich and Zhuravskaya,

[9] The list of the occupations is very detailed. We aggregated some of them. In particular, we defined non-agricultural trade as the sum of the trade in home appliances, trade in metal goods, trade in clothes, trade in fur skins, and trade in art. We define crafts/industry as a sum of processing of fibrous substances, animal products processing, minerals and ceramics processing, chemical production, wine and beer production, beverages and brewing substances production, food processing, tobacco processing, printing, publishing, and paper products, instruments, and watches production, jewellery production, clothes production, carriages and wooden boats production, and other production. We define transport as a sum of water transport, rails transport, horses transport, and other means of transport on land.

2017).[10] Markevich and Dower (Forthcoming) provide data on yields separately for winter and spring crops at the district level (*uyezd*) for two years: 1913 and 1914. We also use data for price of rye by province and year in the European provinces of the Russian Empire between 1860 and 1915 from Mironov (1985, pp.244-252). We deflate these prices to 1860 level using an aggregate price index for the consumer basket in the European Russia from Strumilin (1954, pp.514-515).

**Climate data:** To construct measures of agro-climatic shocks, we use several data sets. First, we use data set that provides information on reconstructed historical seasonal temperature. These data were constructed by Luterbacher et al. (2004) and Xoplaki et al. (2005) and previously used by Ashraf and Michalopoulos (2015) and Buggle and Durante (2017). These temperature data were derived from indirect proxies such as tree rings, ice cores, corals, ocean and lake sediments, as well as archival documents. Luterbacher et al. (2004) and Xoplaki et al. (2005) reconstructed historical temperature by calibrating the indirect proxies to Climatic Research Unit (CRU) gridded data based on weather station observations by Mitchell and Jones (2005) for the twentieth century and extending time-series backward for earlier years. Second, we use observational temperature data from weather stations provided by Global Land Surface Databank (Rennie et al., 2014).

We have compared the two datasets on temperature and found an important discrepancy between the two sources. In 1881 spring was extremely hot in Kiev and its surroundings, where many pogroms took place, according to Global Land Surface Databank data, whereas the levels of spring temperature according to the reconstructed historical climate data by Luterbacher et al. (2004) and Xoplaki et al. (2005) were close to average for that year. Historical accounts do document exceptionally hot weather, which brought "near famine conditions" due to crop failures in areas where pogroms took place in 1881 and 1882 (Aronson, 1990, p.112). As the data based on tree rings and other indirect indicators of seasonal temperature are fairly noisy due to their construction and because for 1881 these data directly contradict the historical narrative in contrast to the observational data from weather stations, we deem the latter as the correct source. Thus, we interpolate the weather station data for 1881 and 1882 and replaced the data provided by Luterbacher et al. (2004) and Xoplaki et al. (2005) for these two years. As there are no other substantial differences between the two sources for other years and the spatial coverage of Global Land Surface Databank is inferior to the reconstructed historical climate data in the earlier period, for all years other than 1881 and 1882, we use the latter source. The reconstructed historical climate data pro-

[10] Data on grain yield at the province level are not available for the Polish provinces of the Russian Empire, called the Kingdom of Poland. There are also a few cross-sections missing between 1862 and 1914.

vide temperatures by season defined somewhat unconventionally corresponding to the four quarters of the year, i.e., winter months are: January, February, March; spring: April, May, and June; summer: July, August, and September; and autumn: October, November, and December.

Using the resulting data set, we construct two measures of seasonal temperature shocks. First, for each grid cell in each season, we calculate the deviation of temperature from the historical mean by taking the difference between the temperature in a grid cell in a season in a particular year and the grid-cell-specific 75-year rolling mean temperature. The rolling mean temperature is used to take into account the long term climate change. We then normalize this variable by the grid-cell specific standard deviation of the season temperature in the corresponding 75-year period to account for variability of climate. All our results are robust to using the mean season temperature for each grid cell over the entire observation period instead of the 75-year rolling mean. Second, we construct dummies for the extremely hot and extremely cold seasons for each grid cell in each year. We set these dummies equal to one if the deviation of temperature from the historical mean in the grid cell, season, and year falls above the 95th percentile of its distribution for the extremely hot and below the 5th percentile of its distribution for the extremely cold season temperature.

**General crime data:** To verify that our results are not driven by the effect of shocks on general crime rather than ethnic violence, we use data on the number of thefts, homicides, and arsons by province for the European provinces of the Russian Empire. Data on the number of thefts and homicides exist for 1900-1912 and for the number of arsons for 1900-1910. (Data for other years are not available.) The number of arsons comes from MIA (1912). Homicides and thefts come from the annual volumes of the statistics of district courts and the chambers of justice published by the Ministry of Justice in St. Petersburg between 1904 and 1915.

## 4.2 Agro-climatic shocks: temperature and agricultural yields

In this subsection, we 1) show that extremely hot temperature in the spring had an important and robust negative effect on agricultural yields in the 19th and 20th century in the area of the Pale of Settlement; 2) discuss the mechanisms through which extremely hot spring during the early growing season causes crop failure for grains; and 3) show that other shocks to seasonal temperature do not robustly affect yields. This evidence allows us to focus on the incidence of extremely hot spring as a measure of a negative agro-climatic shock in the empirical analysis that follows.

Throughout the 19th century and in the early twentieth century, Russian Empire had a predominantly agricultural economy. 85% of the working-age population was employed in agriculture in 1885 and this figure declined only to 82% by 1913; agriculture contributed the most to the Russia's GDP: about 54% of total value added was produced by agriculture in 1885 and about 47% in 1913 (Cheremukhin et al., Forthcoming). Food made up about 55% of the total exports of the Russian Empire, and the empire was the world's greatest grain exporter (Gayle and Moskoff, 2004). Due to the use of backward technologies, climate shocks had a large effect on grain yield. Because of the importance of agriculture to the economy, crop failures had an important effect on incomes.

Which climate shocks mattered for grain production? Agricultural scientists (e.g., Hall, 2001) argue that extremely hot temperature in the early growing season, often referred to as heat stress, causes grain yield to collapse.[11] In the Pale of Settlement, both winter and spring grains were cultivated, with winter grains constituting the majority. Winter grains in that area are planted in September, give head in May and June, and are harvested in July and August; spring grains are planted in April and May, give head in June and July, and are harvested in August and September (Joint Agricultural Weather Facility, and U.S. Department of Agriculture, 1992, p.139). Given this agricultural calendar, for both winter and spring grains, spring, as defined by the reconstructed historical temperature dataset (i.e, the second quarter), represents the growing season, whereas summer (i.e., the third quarter) represents the harvesting season.

Using the available historical data on grain yields, we investigate whether and how temperature shocks in each of the seasons, including the growing and the harvesting seasons, were associated with crop failure. We regress yield in a province and year on the two alternative measures of the temperature shocks in each season in the province and year controlling for year and province fixed effects (to single out variation relevant for the subsequent analysis) and correcting standard errors for spatial correlation within 250 kilometer radius and one spatial lag. Table 2 presents the results. In Panel A of the table, we use dummies for the seasonal temperature shocks and in Panel B – the continuous measures of seasonal temperature deviation from the historical mean to measure temperature shocks. First seven columns present the relationship for each seasonal shock separately and column 8 reports results of regressions with all shocks

[11] This literature defines heat stress as the rise in temperature in the growing season beyond a threshold level for a period of time sufficient to cause irreversible damage to plant growth and development. According to agricultural scientists, high temperatures in the early growing season reduce grain yield, and in particular, wheat yield, through the following interrelated mechanisms: the acceleration of phasic development, an accelerated senescence, a reduction in photosynthesis, an increase in respiration and the inhibition of starch synthesis in the growing kernel (Shpiler and Blum, 1990). Asseng et al. (2015) show that for each additional degree Celsius in global mean temperature, there is a reduction in global wheat production of about 6%.

included together as regressors.[12] We find that the only seasonal temperature shock that has a significant and robust negative effect on yields across different specifications is the extremely hot spring. It is the only shock that is significant in specifications with dummy measures of seasonal temperature shocks (Panel A). In specifications with continuous measures, the coefficients on both spring and summer temperature deviations are statistically significant. However, the negative relationship between the yield and the summer temperature is present only in the lower and the middle part of the distribution (which is why the dummy for extremely hot spring does not affect yields). This is illustrated in Figure 4, which presents the non-parametric relationship between province grain yield and seasonal temperatures (conditional on province and year fixed effects). The figure shows a strong relationship between extremely hot spring and crop failure as well as no relationship between other seasonal temperature shocks and yields.[13]

The magnitude of the effect of the hot spring is substantial: conditional on province and year fixed effects, an extremely hot spring reduced grain yield in a province in the same year by 3,535 thousand *tchetverds*, or 53 percent of the mean grain yield.[14] One standard deviation increase in the spring temperature, on average, lowered the province's grain yield by 1,077 thousand *tchetverds*.[15]

Data on yields for spring and winter grains separately are available at the district level for 1913 and 1914. These years, however, were exceptionally hot. Therefore, using these data we cannot study how different weather shocks affected yields. We can, however, verify that yields were lower in districts where spring season was particularly hot during these years. Figure A5 in the online appendix presents the unconditional

[12] Note that the data on yields by province span from 1862 to 1914. During this period, there were only three hot summers, which equals to 0.45% of the sample defined as the 95th percentile or above of the deviation of the summer temperature from the historical mean over the entire observation period of our study (1800-1927). Thus, we cannot use a dummy for an extremely hot summer as a regressor.

[13] Table A4 in the online appendix establishes the robustness of the relationship between spring temperature shocks and yields to using logs rather than levels. In columns 1 to 8, we replicate Table 2 using log specification.

[14] *Tchetverd* is a unit of volume equal to approximately 209.9 Litres.

[15] Agricultural scholars point out that cold winters also could damage the seeds of winter crops and reduce their yields (Braun and Sãulescu, 2002). In addition, extremely cold weather during the later stages of the growing season may also negatively affect yields of both winter and spring crops (Acevedo, Silva and Silva, 2002). Consistent with these mechanisms, Anderson, Johnson and Koyama (2016) find that colder growing seasons increased the likelihood of Jewish persecutions in the European cities between 1100 and 1600, but not between 1600 and 1800. The time coverage of their study overlaps with the Little Ice Age (LIA). During the LIA, mean annual temperatures declined by 0.6°C relative to the average temperature between 1000 and 2000 CE across the Northern Hemisphere. It is documented that during the LIA frequent cold winters and summers led to crop failures and famines in northern and central Europe (Encyclopædia Britannica, 2015). The temperature levels in Europe have increased between the observation periods in Anderson, Johnson and Koyama (2016) and in our data. The change in climate is the likely reason why crop failures after 1800 occurred following hot growing seasons, whereas they have occurred following cold growing seasons during the LIA.

non-parametric relationship between grain yield in 1913 and 1914 at the district level and the deviation of spring temperature from the historical mean separately for spring and winter grains. As above, we find that grain yield for both types of crops collapsed when spring temperature reached extremely high levels in these two years, i.e., starting with spring temperature of approximately 1.7 standard deviations above the historical mean.

Overall, consistent with the climatology and agricultural literatures, we find that extremely hot temperatures during the early growing season were detrimental to the main output of the agricultural production in the Pale of Settlement.

## 4.3 Grain prices and agro-climatic and political shocks

In this subsection, we show how grain prices are related to yields and to agro-climatic shocks. The Pale of Settlement was a large area, yet, it was small enough to be an integrated market for grain. Provincial prices of grain were highly correlated between provinces within the Pale. Prices in areas which were less suitable for grain cultivation were affected by agro-climatic shocks in areas that were more suitable for grain cultivation (i.e., Ukraine and Southern Poland) as most of the Pale's grain production came from these areas. Figure A6 illustrates these relationships. We divide the Pale provinces into those with above and below median suitability and present in Panel A the aggregate rye output in the two groups of provinces over time. In Panel B, we show the time series of rye prices separately in these two groups of provinces and overlay these time series with shaded areas indicating the times of severe agro-climatic shocks in any of the provinces in the group that was more suitable for rye cultivation in the current or the previous year. We focus on rye because of price data availability. The figure shows that prices in more and less suitable areas co-move and increase with severe climatic shocks in suitable areas.

Table 3 presents the relationship between grain prices, grain yields, and agro-climatic and political shocks more formally for a panel of Pale provinces. As in Table 2, we correct standard errors for spatial correlation within 250-kilometer radius and one temporal lag and control for province fixed effects. The list of covariates in the first five columns also includes year fixed effects. The results are very intuitive. Column 1 shows that grain prices rose on average when crops fell. In columns 2, 3, 4 and 5, we show that local agro-climatic shocks that led to crop failures did not robustly affect grain prices when we consider the sample of all Pale provinces. In contrast, local agro-climatic shocks significantly increased grain prices in provinces suitable for grain cultivation in the same and in the following year. The effect of lagged climatic shock is not surprising as prices for grain were affected by the shocks to yields after the harvesting season of the same year and during the planting season of the following year. In column 6, we show that severe crop failures in provinces that produced most of the grain affected prices for grain in all Pale provinces. We define a dummy, that we call a macro-economic shock, which indicates years when there was a climate shock that caused crop failure in provinces with above-median suitability in the current or the following year. This variable only varies over time. We find that grain prices were significantly higher at times of macro-economic shocks. In columns 7 and 8, we show that the average association between macro-economic shocks and grain price is not affected by political turmoil. But at the times of political turmoil without crop failures prices for grain fell on average. This could happen because some of the episodes of political turmoil led to a collapse of exports of Russian grain to Europe, which in turn led to an excess grain supply inside Russia.

Overall, the analysis presented in the two subsections above motivates the focus on hot springs as a measure of negative local agro-climatic income shocks. Throughout the paper, we use two alternative measures of a spring temperature shock at a grid-cell level: (i) the deviation of spring temperature from the historical grid-cell-specific mean and (ii) the dummy indicating that this deviation is above the 5th percentile of its distribution. In addition, to measure the effect of agro-climatic shocks on grain prices, we use a macro-economic shock indicator variable, which is equal to one if at least some grid cells in the provinces of the Pale of Settlement with grain suitability above median experienced an extremely hot spring in the current or the previous year. For a subset of years, for which the grain price data are available, we also use the price of grain directly to measure the market conditions for grain trade.

# 5 Estimation Strategy

## 5.1 Model

We study the determinants of pogrom occurrence by estimating a linear probability model in a panel setting controlling for all time-invariant unobserved characteristics of the localities with grid cell fixed effects and over-time variation with year fixed effects. We estimate the following equation:

$$V_{it} = \alpha + \beta E_{it} + \gamma E_{it} P_t + \sigma E_{it} P_t M_i + \delta E_{it} M_i + \theta P_t M_i + X'_{it}\phi + \mu_t + \eta_i + \varepsilon_{it}, \quad (1)$$

where $i$ indexes grid cells and $t$ indexes years. $V$ stands for violence; and $V_{it}$ denotes a dummy for the occurrence of pogroms in a grid cell $i$ in year $t$. $E$—for economic shocks—is a measure of agro-climatic negative shocks. We consider two types of economic shocks: local shocks and macro shocks. As described in the data section, local economic shocks are measured in two ways: it is either a dummy for extremely hot spring indicating that the deviation of the spring temperature from its historical grid-cell-specific mean is equal or above 95th percentile of its distribution or a continuous measure equal to the deviation of spring temperature from its historical mean, standardised to have a mean zero and standard deviation of one. The local economic shocks vary both across grid cells $i$ and over time $t$. We also define a macro-economic shock as a dummy that equals one when at least some grid cells in provinces with above median grain suitability in the Pale of Settlement experienced an extremely hot spring in year $t$ or year $t-1$. This shock proxies for an increase in the price of grain in the Pale of Settlement after the bad harvest, which affects prices in the same year and in the following year.[16] The macro shock variable varies only over time, thus, in the specification with this variable, we replace $E_{it}$ by $E_i$ in equation 1. $P_t$ denotes episodes of political turmoil, i.e., the time of extreme uncertainty about the future, it varies only over time. $M_i$—for moneylenders or other middlemen—denotes the share of Jews among moneylenders or among other intermediary professions, such as traders in grain. This variable varies only across grid cells, as it comes from 1897 census. $\mu_t$ is the year fixed effect, and $\eta_i$ is the grid-cell fixed effect. To separate the effect of the presence of Jews from their specialization in middleman occupations, we include interactions of the share of Jews in the local population with economic and political shocks to the set of covariates ($X_i$). To make sure that the estimated effects are not confounded with the level of development of the locality, we also control for the interactions of both types of shocks with the size of the credit sector and with a dummy indicating the absence of the credit sector in the locality.[17]

As both ethnic violence and climate shocks are spatially correlated and correlated over time, we correct standard errors for both spatial and temporal correlations following Conley (1999) and Hsiang (2010). In the baseline specification, we assume that error term of each observation is correlated with error terms of all observations within 100 kilometer radius and 1 temporal lag of this observation. This assumption implies that each observation is spatially correlated with the immediate neighbours to the North and to the South and three rows of neighbouring observations to the East and three rows of neighbouring observations to the West of this observation. We also establish robustness of the results to various alternative assumptions about the

[16]By "macro-economic" shock, we mean the price shock that affects price of grain in the entire Pale of Settlement.

[17]In order to keep the same sample across specifications, we define the share of Jews among moneylenders to be equal to zero when there are no moneylenders in the locality, which happens in 1.22% of the sample. Employment in all other considered occupations is above zero in all localities. The results are robust to excluding observations with zero employment in the credit sector.

variance-covariance matrix. To facilitate the interpretation of estimated coefficients in regressions with the continuous measure of local economic shocks ($E_{it}$), we subtract the sample means from all continuous variables before taking interactions with other continuous variables such that, e.g., instead of the $E_{it}P_tM_i$ covariate, the set of covariates includes $E_{it}P_t(M_i - \bar{M})$.[18]

## 5.2 Instrumental variable approach

Both endogeneity and measurement error may potentially bias the estimation of equation 1. Endogeneity may stem from both omitted variables and reverse causality. Jewish middlemen may have self-selected into places where the non-Jewish majority was less prone to ethnic violence for an unobserved reason. Such endogenous location decisions could create a negative bias in the relationship between pogroms and the share of Jews in middleman occupations.

Reverse causality is also a possible concern. The data on the ethnic and occupational composition come from 1897 census, which took place after the first wave of pogroms of 1881-1882. The share of Jews in the local population and the ethno-occupational structure of localities were affected by the first pogrom wave, as it caused a significant number of Jewish deaths in some areas and also triggered substantial outmigration of Jews to the U.S. and to large cities, in which it was easier to hide.[19] Finally, there is a substantial measurement error in the shares of Jews in middleman occupations and, particularly, in moneylending as historians document that many Jews with reported primary occupation as inn and bar owners also lent money to Gentile majority at interest. All of these potential sources of endogeneity as well as the measurement error are likely to bias the estimates against finding a positive relationship between pogroms and the specialization of Jews in moneylending interacted with economic and political shocks, which we document in the next section.

We correct for these and other potential sources of endogeneity in specialization of Jews in moneylending. Our identification strategy is based on the argument suggested by Botticini and Eckstein (2012) that Jews were more likely to become creditors because of their ability to write contracts as a result of higher literacy rates among them compared to the majority due to the requirement of reading spiritual texts. In particular, we instrument the share of Jews among moneylenders with the gap in literacy between Jews and non-Jews controlling for the overall literacy rate in the locality.

[18] The continuous measure of local economic shocks $E_{it}$ is standardised and, thus, by definition also has a zero mean.

[19] The outmigration of Jews from the Russian Empire following pogrom waves originated not only from localities where pogroms took place, but also from localities where violence did not occur, but Jews nonetheless feared pogroms (Spitzer, 2015*b*).

The difference in the literacy rates between Jews and the non-Jewish majority is a strong predictor of the share of Jews among moneylenders. Figure 5 illustrates this relationship with a scatterplot conditional on the local literacy rate, the share of Jews and the share of moneylenders in total employment. The identification assumption is that, controlling for the overall literacy rate and other covariates, the difference in the literacy of Jews and non-Jews affects pogroms only through its effect on the competitive advantage of Jews in moneylending. Figure A7 in the online appendix shows that total literacy rate is uncorrelated with the literacy of Jews and is strongly correlated with literacy of non-Jews. Thus, the total literacy rate interacted with both political and economic shocks is an important control, which we include in baseline IV estimation: it proxies for the literacy of the potential perpetrators, which may be correlated with the propensity for violent behaviour. There is no *a priori* reason why the literacy of potential victims should affect pogroms, other than through its effect on the occupational choice of the minority. Figure A8 in the online appendix presents the maps of spatial distributions of the literacy gap between Jews and non-Jews and of the total literacy rate. In order to make the first stage more precise, we also include a dummy for the three historic capitals, Kiev, Warsaw, and Vilnius, interacted with economic and political shocks in the set of covariates of the baseline IV specification because the literacy rate of non-Jews is substantially and significantly higher in these three cities compared to other localities in the Pale of Settlement. In order to calculate standard errors corrected for spatial and temporal correlations in IV regressions with fixed effects, we follow the strategy developed by König et al. (forthcoming).

As the literacy gap between Jews and the local majority may affect Jewish presence in other occupations in addition to moneylending, we verify that the IV results are robust to controlling for the shares of Jews in other occupations interacted with agro-climatic and political-turmoil shocks. As a robustness check, we also control for urbanization level interacted with economic and political shocks because literacy rates of both the majority and the minority may be correlated with urbanization and find no effect of the inclusion of this covariate on our estimates. We have no instrument to correct for potential measurement errors or endogeneity biases in specialization of Jews in trade in grain, so we rely on OLS knowing that the biases are likely to be against our findings.

To sum up, we use the literacy gap between Jews and non-Jews as an instrument for the share of Jews among moneylenders to estimate equation 1 with 2SLS controlling for the interactions of political and economic shocks with the total literacy rate.

# 6 Results

## 6.1 Pogroms, local economic shocks, and political turmoil

First, we test for the relationship between pogroms and economic and political shocks. As a starting point, we verify that the local economic shocks increased the probability of ethnic violence against Jews in the Pale of Settlement on average. Panel A of Figure 6 illustrates this by showing a sharp increase the likelihood of pogrom occurrence in the grid cells and years that experienced extremely hot spring. The figure presents the unconditional non-parametric relationship between the occurrence of pogroms and the deviation of spring temperature in a grid cell and year from its historical grid-specific mean on the whole sample from 1800 to 1827. Column 1 of Table 4 shows that this relationship is robust to including year and grid-cell fixed effects. In this and all other tables in the paper that consider local economic shocks, in Panel A, we report results using dichotomous measure of the local economic shocks, i.e., a dummy for extremely hot spring and, in Panel B, we report results using the continuous measure of the local economic shocks, i.e., the deviation of spring temperature from its historical mean. In both specifications, the coefficient on the proxy for the negative income shock is positive and statistically significant. This relationship was documented in other settings by the previous literature (e.g., Miguel, 2005; Anderson, Johnson and Koyama, 2016). However, as we show in the Figure 2, not all economic shocks led to ethnic violence. Column 2 of Table 4 presents the relationship between pogroms and local economic shocks separately during the times of political turmoil and outside those times. We find that local economic shocks have no effect on pogroms during times of a relative political stability: the coefficients on both proxies for local economic shocks (not interacted with a dummy for political turmoil) are precisely-estimated zeros. In contrast, the coefficients on the interaction between the proxies for local economic shocks and political turmoil are positive, large, and statistically significant. Panel B of Figure 6 presents the non-parametric relationship between the spring temperature deviation and pogroms focusing only on the years of political turmoil. Comparing the two panels of the figure, one can see that the likelihood of pogroms is generally much higher during the times of political turmoil and particularly so in localities that were affected by a local negative agro-climatic shock.

Point estimates imply that the occurrence of a hot spring during the times of political turmoil increased the probability of a pogrom in a grid cell by 3.8 percentage points or 54% of standard deviation of pogrom occurrence (Panel A of Table 4). According to the estimation using the continuous measure of economic shocks, a one standard deviation increase in the spring temperature led to a 2 percentage point increase in the probability of a pogrom (Panel B of of Table 4). The mean probability of a pogrom in a grid cell in any given year during 1800–1927 was 0.5%. Column 3 of the table presents regressions for pogroms that occurred during the agricultural season—from April to October, which constitute 71.4% of all pogroms—and column 4 for pogroms outside the agricultural season, i.e., from November to March. Only those pogroms that occurred during the agricultural season were significantly affected by local economic shocks. This is to be expected, as we focus on the agricultural income shocks, i.e., the shocks realised during the agricultural season.

Theoretically, hot weather *per se* might lead to more anti-Jewish violence during political turmoil by making people too hot and, as a result, agitated and violent. Experimental studies in psychology showed that higher ambient temperatures may increase interpersonal hostility (Kenrick and MacFarlane, 1986; Vrij, Van Der Steen and Koppelaar, 1994). Columns 5 and 6 show that pogroms were affected by agro-climatic shocks through their effect on harvest, and therefore, agricultural incomes rather than directly: we regress the probability of pogrom occurrence during the harvesting season only (i.e., between August and October) on the agro-climatic shocks in the spring (April to June), i.e., the shock that affects subsequent yields, and also find a significant positive relationship irrespective of whether we directly control for the temperature shocks during the harvesting season, which is done in column 6.

## 6.2 Pogroms and Jewish middlemen

### 6.2.1 Jews in moneylending and local economic shocks

In this section, we explore how Jewish specialization in moneylending affected the probability of violence against Jews in the midst of economic and political shocks. Table 5 presents OLS results. As above, the two panels of the table present results for alternative measures of the local economic shocks. For the sake of comparison, column 1 restates the results presented in column 2 of Table 4. In column 2, we show that pogroms during political turmoil and local economic shocks were more likely in localities with more numerous Jewish community relative to the size of the population. This is what one should expect given that Jews were a minority everywhere in the Pale. The share of Jews across grid cells varied form 0.9 to 24.9%. This relationship is statistically significant in specification with the dichotomous measure of local economic shocks and is imprecisely estimated in specification with continuous measure.

In column 3, we investigate how the probability of pogroms was affected by the share of Jews among moneylenders. We find that the coefficient on the triple interaction of the share of Jews in moneylending with local economic shocks and political turmoil is positive and statistically significant in both specifications. The share of Jews in a locality is positively—although not very strongly—correlated with the share of Jews among moneylenders as can be seen from the Panel A of Figure A4 in the online appendix. To account for this correlation, in column 4, we include interactions of shocks with both the share of Jews in local population and among local moneylenders. This is our main specification. In both panels of the table, the coefficients on triple interactions of the share of Jews among moneylenders and political and economic shocks are positive and statistically significant. The coefficients on the share of Jews in local population interacted with the economic and political shocks is also positive but not precisely estimated.[20] To illustrate these effects, Panels A and B of Figure A9 in the online appendix present the cumulative distribution functions of the share of Jews in local population and of the share of Jews among local moneylenders, separately for the grid cells with and without pogroms among grid cells which experienced agro-climatic shock during political turmoil. Both of these distributions are substantially skewed to the right for localities that experienced pogroms.

The magnitude of these effects (according to estimates presented in Panel A of Table 5) is as follows. At times of political turmoil and local economic crisis, a one standard deviation increase in the share of Jews (=0.051 percentage points) leads to an increase in the probability of a pogrom by 2 percentage points, or 28% of standard deviation of pogrom occurrence (according to estimates from column 1). A one standard deviation increase in the share of Jews among creditors (=0.28) conditional on the local share of Jews leads to an increase in the probability of a pogrom by 1.6 percentage points, i.e., 22.4% of standard deviation of pogrom occurrence.

The magnitudes of these effects suggests that at time when and in places where local economic shocks coincided with political turmoil, Jewish creditors were the primary target of pogrom perpetrators ("*pogromschiki*"). Historians documented that the victims of large pogroms included people of both genders and all ages: men, women, and children. In addition, given the number of Jews among moneylenders, it is clear that far from all pogrom victims were directly related to Jewish creditors. However, the estimates do suggest that the origin of pogroms at the intersection of local economic shocks with political turmoil was related to the presence of Jewish moneylenders. To illustrate this, consider several alternative scenarios in an average district with 219,669 people, 22,656 Jews, 81 creditors, 44 Jews-creditors. If ten Jews entered the district,

[20]Note that, in Panel B, we subtract sample means from each continuous variable (i.e., the share of Jews, the share of Jews among moneylenders, and the deviation of the spring temperature from its historical mean), so that the coefficient on the interaction between the spring temperature deviation and political turmoil is estimated at the mean level of each of these variables in Panel B. In contrast, in Panel A, none of the variables are demeaned, so that the coefficient on the interaction between dummies for hot spring and political turmoil in columns 2 to 4 is evaluated at the point where the share of Jews equals zero, which is out of the sample. This is why these coefficients are constant across columns in Panel B and vary in Panel A.

the probability of pogrom at the time of political and economic shocks, would have increased by 0.0016 percentage points; if ten Jewish moneylenders entered the district, the probability of pogrom would have increases by 0.286 percentage points; if ten Jews in the district switched to credit from other occupations, the probability of pogrom would have increases by 0.285 percentage points. To get the increase in the probability of pogrom equal to the one caused by ten Jews-creditors entering the district, 1 821 Jews needed to enter the district.

As we have discussed in the methodology section, these estimates could be biased downwards because of a measurement error, omitted variables, and reverse causality. We address this issue in Table 6 using instrumental variables estimation. Columns 1 to 3 present the first stage relationship in which each of the interactions of the share of Jews among moneylenders with local economic shocks and political turmoil is instrumented by the respective interactions of the gap in literacy between Jews and non-Jews with the same shocks controlling for the interactions of the total local literacy rate and of the dummy for three historical capital cities with these shocks. The first stage is sufficiently strong not to worry about weak instrument problem. We present the F-statistics for the excluded instruments at the bottom of each panel. Column 4 reproduces the OLS results, for the sake of comparison. And columns 5 and 6 present the results of the second stage of the 2SLS regressions. Column 5 presents the baseline, and in column 6, we add an additional control for the interactions of local urbanization level with the economic and political shocks. The effect of the share of Jews among moneylenders in IV regressions remains statistically significant irrespective of specification and the magnitude of the point estimates increases by a factor of 4.6. According to the IV results with a dichotomous measure of local economic shocks (Panel A), a one standard deviation increase in the share of Jews among moneylenders increased the probability of a pogrom in localities hit by a local economic shock at times of political turmoil by 7.3 percentage points (14 times from the mean value of 0.51%), which is equal to one standard deviation of pogrom occurrence. In addition, consistent with the idea that total literacy proxies for the inverse of the propensity of potential perpetrators to violence, we find that the interaction of the total literacy rate with political turmoil, which particularly for the last wave of pogroms was associated with a weak state, is significantly negatively associated with pogroms.

The share of Jews among moneylenders may be correlated with the share of Jews in other occupations. The literacy gap between Jews and non-Jews may increase the specialization of Jews in other occupations that require literacy in addition to moneylending. In order to make sure that our results are not driven by such correlations, we verify that the results are robust to including in the list of covariates the interactions of local economic shocks and political turmoil with the shares of Jews in other main Jewish occupations. Table A5 in the online appendix presents the results. We find that both the OLS and IV results about the effect of the share of Jews among moneylenders are robust. The coefficients on the triple interaction of the share of Jews among moneylenders with local economic shocks and political turmoil remain statistically significant and stable in magnitude when we control for the interactions of both economic and political shocks with the shares of Jews among traders in grain, among traders in non-agricultural goods, in employment in crafts and industry, and in transport. Columns 1 to 4 include these controls one by one and in column 5, we include all of them together. Due to the space limitations, in this table we do not report the coefficients on the interactions of shocks with the shares of Jews in these other occupations; in the next section and in the tables that follow, we focus on these interactions to examine how specialization of Jews in these other occupations affects pogroms.

In Table A6 in the online appendix, we investigate the robustness of our OLS and IV estimates to using alternative assumptions about variance-covariance matrix. In column 1, we replicate the results using clusters by grid cell, in columns 2 to 7 we change the parameters of Conley spatial correction of standard errors by varying both the range for spatial and for over-time correlations. Our results are robust: the coefficient on the triple interaction term between the share of Jews among moneylenders, local economic shocks, and political turmoil remains statistically significant in all specifications.

To sum up, we find that the specialization of the Jewish minority in moneylending significantly increased the likelihood of anti-Jewish violence in the face of local agro-climatic shocks intertwined with political turmoil.

### 6.2.2 Jewish specialization in other occupations and local economic shocks

In this section, we consider how the specialization of Jews in other occupations affects the probability of pogroms. We start with estimating the same specification as for the share of Jews among moneylenders, i.e., looking at the effect of the interactions of local economic shocks and political turmoil with the share of Jews among local traders in grain, among local traders in non-agricultural goods, among all locally employed in crafts and industry, and in transport sector. In these specifications, we always control for the full set of interactions of the share of Jews in local population and the share of Jews among moneylenders as both can be correlated with the specialization of the minority in these other occupations.[21] Table 7 presents the results. Columns 1 to 4 include interactions with the share of Jews in different occupations one by one and column 5 includes full set of interactions with all five occupations (including the share of

[21]Figures A3 and A4 in the online appendix present the distribution of the shares of Jews in local employment in different occupations across grid cells and the scatter plots of the relationship between the shares of Jews and the shares of Jews among employed in these occupations across grid cells.

Jews in moneylending, which is always included in the set of covariates). First, we find that local economic shocks' interaction with specialization of Jews in these other occupations do not affect the probability of pogroms in (or outside) the times of political turmoil. This result provides a sharp contrast to specialization of Jews in moneylending, the interaction of which with political turmoil and local economic shocks is a very important determinant of pogroms. The triple interactions of local economic shocks, political turmoil, and the shares of Jews in occupations other than moneylending are never statistically significant. There is a small and marginally significant coefficient on the interaction of hot spring dummy with the share of Jews among non-agricultural traders, but it is unrobust to controlling for specialization of Jews in other occupations and to using continuous measure of local economic shock. Thus, we conclude that local economic shocks do not affect the probability of pogroms in localities where Jews dominate middleman and non-middleman occupations, other than moneylending. Second, we find that localities where the share of Jews among traders in grain was particularly high experienced significantly higher frequency of pogroms at times of political turmoil irrespective of whether they were hit by a local economic shock. The coefficient on the interaction of political turmoil dummy with the share of Jews among traders in grain is positive and statistically significant in all specifications. We also find that the coefficient on the interaction of political turmoil with the share of Jews in crafts and industry is negative and significant. This result is also robust across specifications.

From Figure 2, we know that political turmoil alone, without crop failures, did not cause pogroms. It is the combination of political turmoil with some crop failures that triggered each of the three pogrom waves. Thus, the significant coefficients on the interactions between political turmoil and the shares of Jews in trade in grain and in industry and crafts must hide some important sources of heterogeneity. We address this heterogeneity below.

#### 6.2.3 Jews in trade in grain and macro-economic shocks

As severe crop failures in more suitable areas of the Pale affected prices for grain everywhere inside the Pale, we use a dummy for a macro-economic shock, equal one in years such that at least some suitable areas in the Pale of Settlement experienced agro-climatic shock in current year or the previous year. We estimate equation 1 with OLS substituting $E_{it}$ by this measure of macro-economic shocks, $E_t$, focusing on the specialization of Jews in trade in grain and other Jewish occupations. Given the importance of the interaction of the specialization of Jews in credit with local economic shocks and political turmoil, we always control for the interactions of both local and macro-economic shocks and political shocks with the share of Jews among moneylenders. Panel A of Table 8 reports the results. We find, as expected, that the effect on the share of Jews among traders in grain during political turmoil presented in Table 7 comes entirely from the years when political turmoil intertwined with macro-economic shocks. The coefficient on the triple interaction between the share of Jews among grain traders, the macro-economic shock, and political turmoil is positive, significant, and larger in magnitude than in the previous table. At the same time, we find that there is no additional explanatory power of the macro-economic shocks' interaction with the share of Jews among moneylenders. (The interaction of local shock during political turmoil and the share of Jews among moneylenders is always significant.) Thus, we conclude that Jewish specialization in moneylending mattered for pogroms during political turmoil only in localities that were directly affected by crop failures, whereas Jewish specialization in trade in grain was important for pogroms during crop failures intertwined with political turmoil in all localities where there was a market for grain and not only those where grain was produced. Presumably, local shocks were more important for creditors and macro shocks were more important for grain traders because of the differences in the nature of these middleman occupations: credit was supplied to peasants in localities, where the grain was cultivated, whereas traders brought grain to the cities, which were the locus of the demand for grain. Presumably, Jewish grain traders were targeted when and where political turmoil and a macro-economic shock coincided because they were blamed for higher grain prices by buyers of grain and Jewish creditors were targeted because local peasants could not repay their loans.

Specialization of Jews in other occupations was not an important determinant of pogroms during the intersection of economic and political shocks. The share of Jews in crafts and industry interacted with political turmoil has a negative and significant coefficient. This may be explained by the fact that crafts and industry was one of the most popular and the least well-defined occupations among the Jewish occupations. It correlates the most with the share of Jews as can be seen on Figure A4. The inclusion of the share of Jews in the local population together with the share of Jews in industry and crafts into the set of covariates may have resulted in multicollinearity. Only in specifications with the share of Jews in crafts and industry, the interaction of political turmoil with the share of Jews in population becomes strongly positive and significant. In addition, there is no negative effect of the interaction of the share of Jews in crafts and industry with shocks if we do not control for the share of Jews interactions with shocks.[22]

In Panel B of Table 8 we combine $P_t$ and $E_t$ in a single dummy indicating years when the periods of political turmoil coincided with macro-economic shocks. We do

[22] Other coefficients are not significantly affected by the inclusion of the interactions of shocks with the share of Jews.

this to avoid the inclusion of interactions of the shares of Jews in different occupations with the two dummies measuring two types of shocks separately, which as shown in Panel A, just adds noise to the estimation. The results of this more parsimonious specification are similar and the effect for the specialization of Jews in trade in grain is more precisely estimated. To illustrate these results, Panel C of Figure A9 presents the cumulative distribution function of the share of Jews among grain traders separately for grid cells that did and that did not experience pogroms during the intersection of macro-economic shocks with political turmoil. Importantly, the distribution of the share of Jews among traders in grain is substantially skewed towards 100%, which explains why the effect is concentrated in the first two quartiles of the distribution (as can be seen from Panel B of Figure 3.

The magnitude of this effect is as follows: a one standard deviation increase in the share of Jews among grain traders (which is equal to 18 percentage points) increases the probability of pogrom occurrence by 1.2 percentage points or 17.7% of the standard deviation of the pogrom occurrence. This effect is somewhat smaller than that for creditors and local economic shocks, but it is still sizeable, especially, given that we have no instrument for the share of Jews among grain traders while the OLS estimates are likely to have an attenuation bias as we discussed in section 5.2.

Table A7 in the online appendix establishes the robustness of the results about the effect of the domination of Jews in trade in grain on the probability of pogroms to alternative assumptions about the variance-covariance matrix. These results are also robust.

As can be seen from the distribution of the share of Jews among traders in grain (presented in Panel C of Figure A3), Jews dominated trade in grain in almost all localities in the Pale. Therefore, the relevant variation in whether Jewish traders were blamed for high grain prices may not have been the share of Jews in trade in grain (which was close to one) but the number of Jewish traders in grain (which varies a lot more across localities in the Pale). In the first two columns of Table 9, we regress pogrom occurrence on the interaction of the macro-economic and political shock with the log number of Jews in trade in grain. (In all other respects, we use the same specification as in Panel B of Table 8.) The two columns differ in the set of covariates: column 2 controls for the interaction between the macro-economic and political shocks with the shares of Jews in other Jewish occupations. Irrespective of specification, we find a significant positive effect of the number of Jews in trade in grain on the probability of pogrom occurrence at the intersection of political and macro-economic shocks.

Finally, in columns 3 and 4, we test for the relationship between pogroms and the interaction between grain prices (as an alternative measure of macro-economic shocks) and the number of Jewish grain traders at the times of political turmoil. This analysis can only be done on the subset of years for which grain price data are available, namely, 1860-1915. Our main focus is the triple interaction of log grain price, log number of Jews in grain trade, and a dummy for political turmoil. In both specifications, we control for the full set of double interactions and for the price of grain (which varies both over time and across provinces). In column 3, there are no additional covariates other than the year and grid-cell fixed effects and, in column 4, we control for the interactions of grain prices and political shocks with the shares of Jews in other occupations. Irrespective of the set of covariates, the triple interaction between log grain prices, the log number of Jews in trade in grain and a dummy for political shock has a robust positive effect on pogrom occurrence.

# 7 Potential alternative mechanisms

## 7.1 Enforcement

The state capacity to enforce order as well as all other state institutions collapsed with the October 1917 revolution and the subsequent Civil War. In Table 10, we split the sample into two periods 1800-1916 and 1917-1927 and study how pogroms were related to Jewish domination over middleman occupations during shocks separately in the two subsamples. Our main results hold both before and after 1917. The magnitude of the point estimate of the effect of the share of Jews in credit on pogroms during local economic shocks and political turmoil increases by a factor of 2.7 in the sample after the collapse of law-enforcement institutions compared to the pre-1917 sample, suggesting that the lack of enforcement exacerbated violence. However, the point estimate of the effect of the number of Jews in trade in grain during macro-economic shocks and political turmoil has similar magnitude in both sub-samples. The results from pre-1917 subsample suggest that the decrease in the probability of punishment cannot be the main explanation for pogroms taking place when income shocks coincided with the times of political turmoil and not taking place when income shocks occurred outside those times.

## 7.2 General crime and arsons

Overall level of crime may increase with both economic and political shocks (e.g., Bignon, Caroli and Galbiati, 2015). Could our estimates be picking up this effect? To address this question, we consider thefts, homicides, and arsons as outcomes. The data for these aspects of general crime exist only at a province level for the European provinces of the Russian Empire in the beginning of the 20th century for a period including the second wave of pogroms. In the first three columns of Table 11, we present regressions on the sample of Pale provinces, in which we relate log numbers of thefts, homicides, and arsons to economic shocks, political turmoil and specialization of Jews in credit and in trade in grain with province and year fixed effects correcting standard errors for spatial correlation. We find no statistically significant relationship between our main explanatory variables, namely, the triple interaction terms between local economic shocks, political turmoil, and the share of Jews among moneylenders or between macro-economic shocks, political turmoil, and the number of Jewish traders in grain, on the one hand, and thefts and homicides, on the other hand. In contrast, specialization of Jews in moneylending in times when local shocks and political turmoil coincided significantly increased the number of arsons. According to Jewish historians (e.g., Dubnow, 1920; Klier, 2011), arsons may have been used as a form of intimidation and violence directed specifically at Jews. Klier (2011) suggests that this was the case, but argues that this claim remains to be proven. Arsons of Jewish property took place in areas, where pogrom enforcement was especially tough and the perpetrators expected severe punishment in case of an open pogrom. For example, during the first wave of pogroms, there were *"serious fires in Jewish centers such as Slonim, Novogruda, Bobruisk, and Minsk. A letter describing the fire in Minsk noted that 'the state of minds here is extremely troubled: many see the fires as a variant of the south-Russian pogroms; all Christian homes have icons placed in their windows; the Jews are all packing up, and await new fires from day to day"'* (Klier, 2011, pp.54-55). Frierson (2002), a historian of the "Red Rooster," a term that denoted arsons in the Russian Empire, showed that Pale provinces were among the most arson-prone in the empire. Unlike pogroms or such general crimes, as homicides and theft, arsons, were much harder to prove, especially during droughts and hot weather, as houses in Eastern European Russia were predominantly wooden and therefore highly inflammable. However, for that same reason, arson was a very high-risk strategy for pogrom perpetrators as in hot weather fires spread easily and in many settlements Jews and non-Jews lived side by side.

Interestingly, the coefficient on the triple interaction between political turmoil, local economic shock, and the log of the total number of creditors in a province (row 3, column 3) is positive and statistically significant for arsons. To test whether arsons were also more numerous during economic and political shocks in provinces with larger number of creditors, irrespective of their ethnic or religious background, we focus on provinces outside the Pale, where Jews were a negligible minority.[23] Looking

[23]Note that local economic shocks during the sample period with crime data available occurred only at times of political turmoil, so we cannot estimate the effect of economic shocks outside political

at provinces outside the Pale allows us to test more generally whether crime and arsons increased disproportionally following shocks in provinces with a larger number of people in the middleman occupations servicing agriculture: moneylending and trade in grain.[24] Columns 4 to 6 of Table 11 present the results. We find no effect of the number of traders in grain during shocks on any of the considered outcomes. As far as the number of creditors during economic and political shocks is concerned, we find that it has no effect on the number of homicides and thefts and a significant positive effect on the number of arsons.

Overall, these results suggest that pogroms were not just a sub-component of an increase in general crime at the time of severe shocks because, otherwise, we would have found similar results for homicides and theft. At the same time, the evidence is consistent with the possibility that insolvent peasants set creditors' houses on fire at times when local shocks intertwined with political turmoil irrespective of creditor's identity. However, we do find that conditional on the total number of creditors, arsons were more frequent in provinces within the Pale of Settlement when Jews rather than other ethnic groups dominated moneylending, which is consistent with historians' view that some pogroms took form of arsons.

## 7.3 Relative income

Jews were heavily discriminated in the Russian Empire. Double taxation and severe restrictions on economic activity caused widespread poverty among Jews in the Pale. Historians suggest that, on average, Jews were poorer than the majority. Agro-climatic shocks led to changes in incomes of non-Jews relative to Jews. Mitra and Ray (2014) argue that ethnic and religious violence could be caused by changes in the relative incomes of two competing ethnic groups. They consider Hindu-Muslim violence in India. There are no data on incomes of Jews and non-Jews and therefore one cannot directly test for the relative income of the two groups as a potential mechanism. However, the evidence presented above is inconsistent with it being the main mechanism.

First, if the shocks to economic inequality were the main mechanism behind pogroms, it is not clear why pogroms did not occur during severe crop failures outside political crises, as political turmoil did not have a direct effect on relative incomes.

Second, Mitra and Ray (2014) stress the importance of economic competition between the two groups as a channel through which relative income affects group violence. They recognize that in the case of occupational segregation theoretical results about the link between economic inequality and conflict may not hold. As Jews and non-Jews

turmoil.

[24] In Table A8 in the online appendix, we verify that our definition of local and macro-economic shocks is reasonable for the provinces outside the Pale.

were segregated into different occupations throughout the Pale, competition-driven violence could not explain pogroms.

Third, the changes in the income gap between non-Jews and Jews following crop failure depended on Jewish occupational composition in a way that is inconsistent with changes in relative income being the mechanism. Peasants (i.e., the main non-Jewish occupation throughout the Pale) were hit the hardest by crop failures. The income of Jews changed differently depending on whether their primary occupation was grain traders, creditors, or traders in non-agricultural goods and craftsmen. For incomes of those Jewish occupations that were not directly related to agriculture, such as industrial workers and traders in non-agricultural goods, crop failures could have had an effect only via a fall in demand caused by the shock to peasants' income. In contrast, middlemen related to agriculture were affected directly, but differently, depending on the type of middleman occupation. The income of creditors, who lent money to peasants, must have declined sharply due to the increase in the default rate as peasants could not repay their loans. In contrast, the income of traders in grain should not be affected as traders passed purchaseprice increases throughto grain buyers. If traders exercised monopoly power, the incomes of traders in grain could even rise with an increase in grain prices. Overall, it is reasonable to conclude that the relative incomes of Jews and non-Jews were affected by crop failures more in localities where the Jews were traders in grain than in localities where they were traders in non-agricultural goods and even more so compared to relative incomes in localities where the Jews were creditors. As the effects of crop failures (during political turmoil) in places where Jews dominated trade in grain and lending are similar, and there is no effect in localities where Jews dominated other professions, despite the differences in the effects on the relative income of Jews and non-Jews, it is unlikely that the shocks to the relative income is the mechanism at play.[25]

# 8 Conclusion

Minorities may avoid conflict by minimizing inter-group competition and making themselves useful to the majority by segregating into occupations, which the majority traditionally choses to avoid. Specialization of Jews in middleman occupations, such as creditors and traders, in Medieval Western and Modern Eastern Europe, was a prominent example of such conflict-reducing economic segregation.

[25]Note that the literacy gap between Jews and non-Jews, which we use as an instrument for the share of Jews among moneylenders, in addition to occupational segregation may pick up the average differences in relative incomes across localities. However, for the reasons described above, shocks to relative income cannot be the main mechanism behind pogroms.

In this paper, we show that severe economic shocks did not cause violence against Jews in the 19th and early 20th century Eastern Europe unless they coincided with a sharp increase in political instability. At the end of the 19th and the beginning of the 20th century, the level of political instability in the Russian Empire was unprecedented. It could not have been foreseen by the Jews or by the majority, suggesting that middleman occupations were *a priori* an optimal choice for the society to reduce the risk of inter-group conflict. Political uncertainty reduced the present value of the middleman minority to the majority, such that negative economic shocks resulted in three major pogrom waves, during which the Jewish middlemen became the primary target. Peasants turned against local Jewish creditors when they could not repay their loans due to severe crop failures and found the future too uncertain to renegotiate or refinance. Similarly, buyers of grain turned against Jewish grain traders, blaming them for price increases, actually caused by crop failures, when they stopped valuing future services of these traders. Pogroms, then, spread to other subgroups of Jewish population.

Broader lessons from this analysis are that political shocks interact with income shocks to trigger conflict and the segregation of a minority into middleman occupations can be both a safeguard and a catalyst of conflict depending on the political and economic environment.

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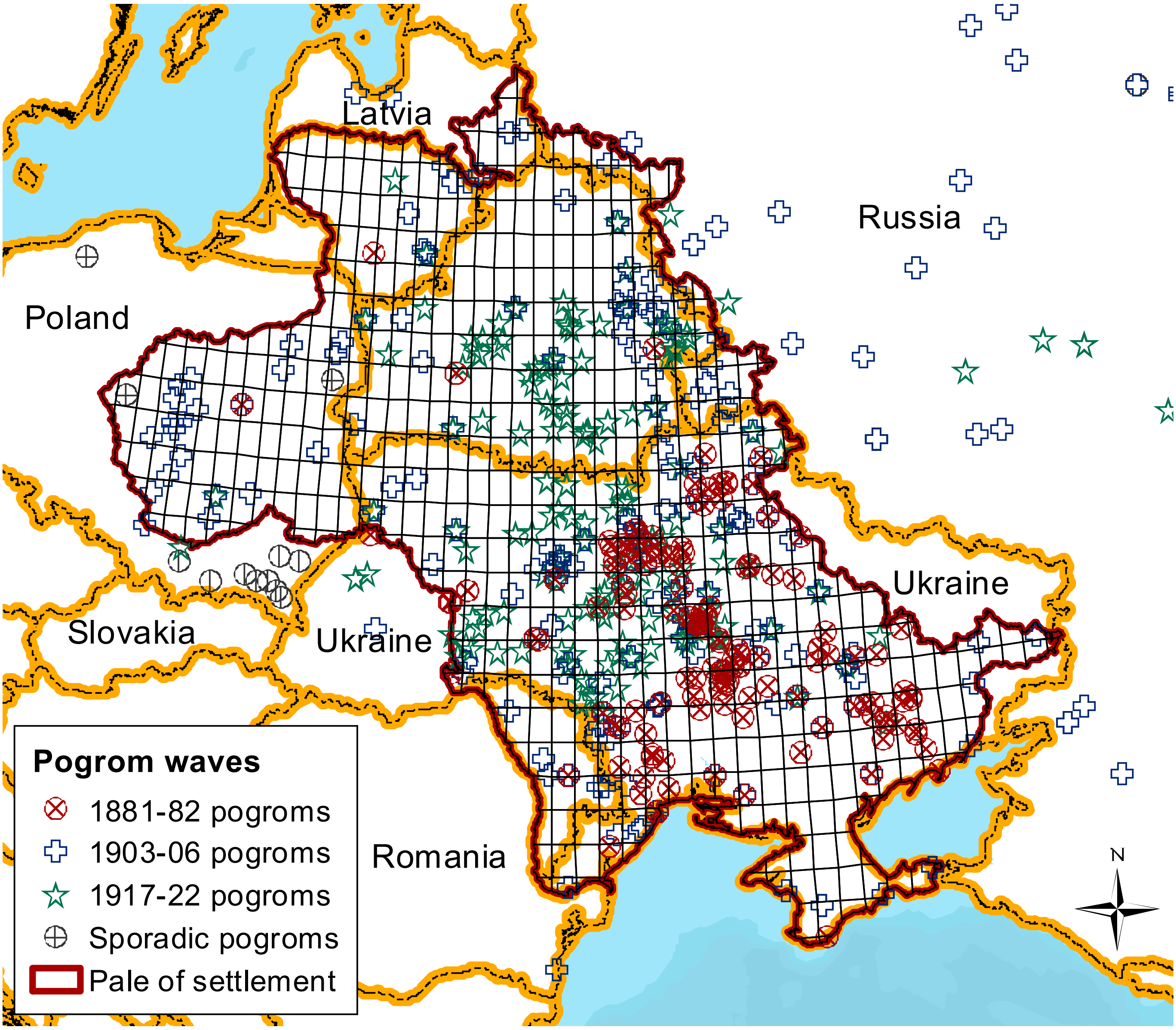
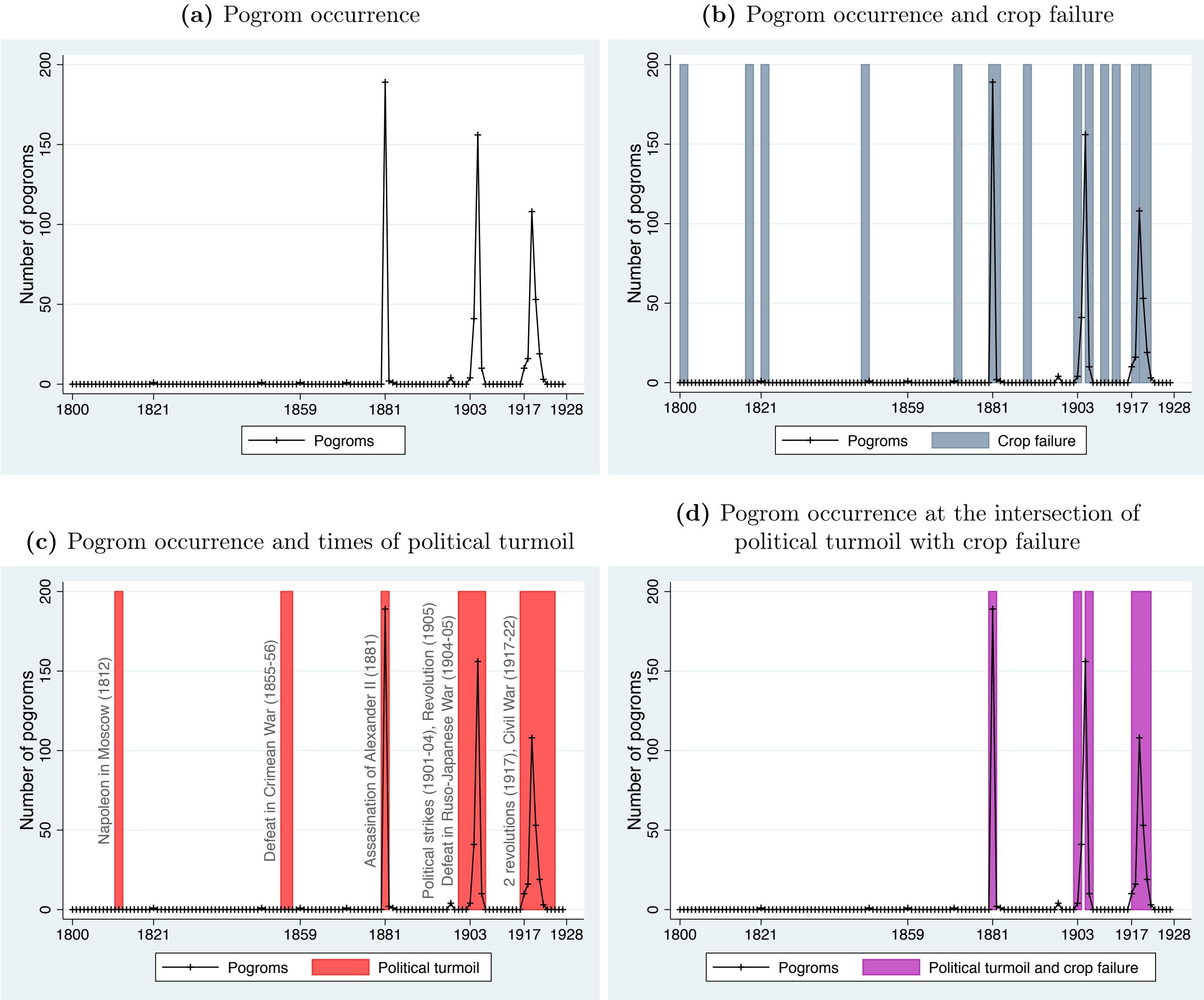
**Figure 1:** The Pale of Settlement and the geographic distribution of pogroms by wave




**Note:** The map presents the geographic distribution of pogroms in Eastern Europe in each of the three pogrom waves. The red line represents the borders of the Pale of Jewish Settlement. Orange lines represent modern country borders. The grid represents the geographical unit of analysis; each gris cell is 0.5 x 0.5 degrees. One degree of longitude is approximately 79 km at the southernmost part of the Pale of Settlement and 63.9 km at the northernmost part of it. The Pale of Settlement is about 1400 kilometres in the South-North direction and 1250 kilometres in the East-West direction.

**Figure 2:** Pogrom waves and the intersection of crop failures with political turmoil




**(a)** Pogrom occurrence

**(b)** Pogrom occurrence and crop failure

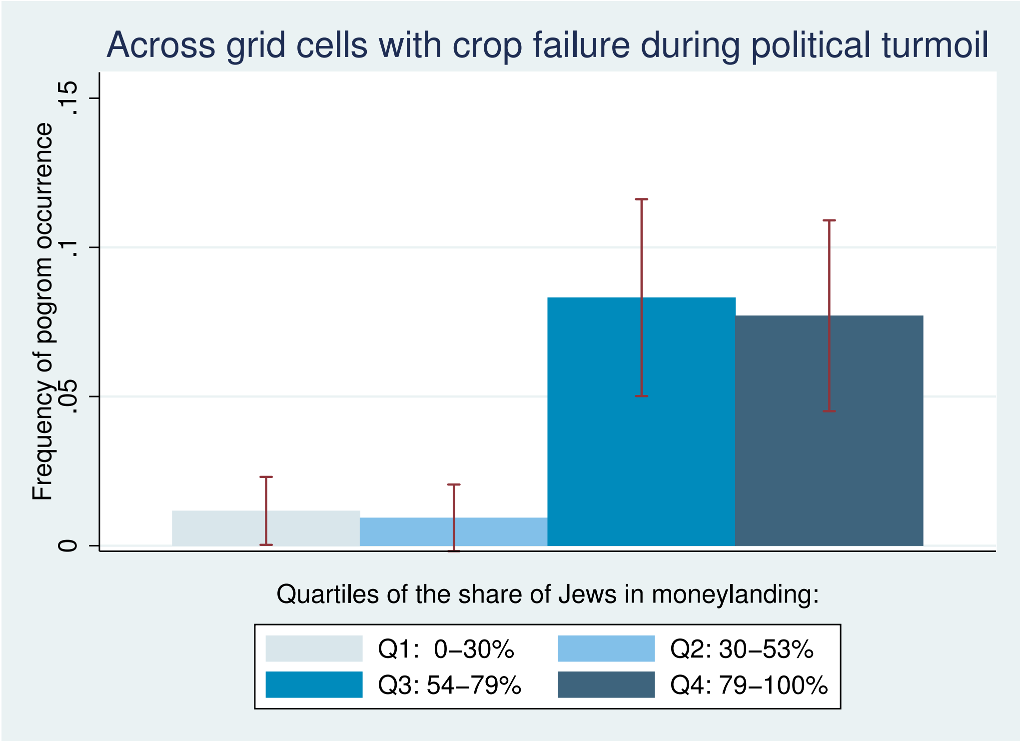
**(c)** Pogrom occurrence and times of political turmoil

**(d)** Pogrom occurrence at the intersection of political turmoil with crop failure

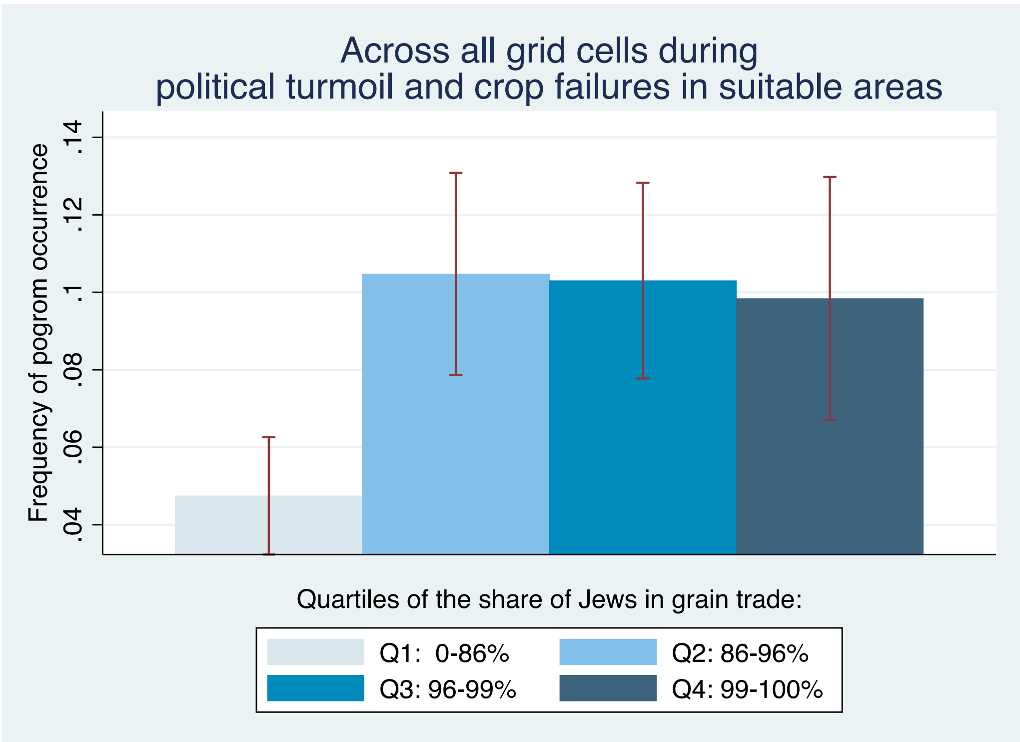
**Note:** The figure presents the number of pogroms over time in the Pale of Jewish of Settlement. Panel A presents the time series of the number of pogroms. Panel B adds to this time series the shaded periods when at least some geographic areas with high suitability for grain cultivation within the Pale suffered crop failures. Panel C highlights the periods of extreme political uncertainty. Panel D presents the periods when crop failures coincided with political turmoil.

**Figure 3:** Shares of Jews in moneylending and trade in grain and pogrom occurrence

**(a)** Share of Jews among moneylenders across localities with local economic shock during political turmoil

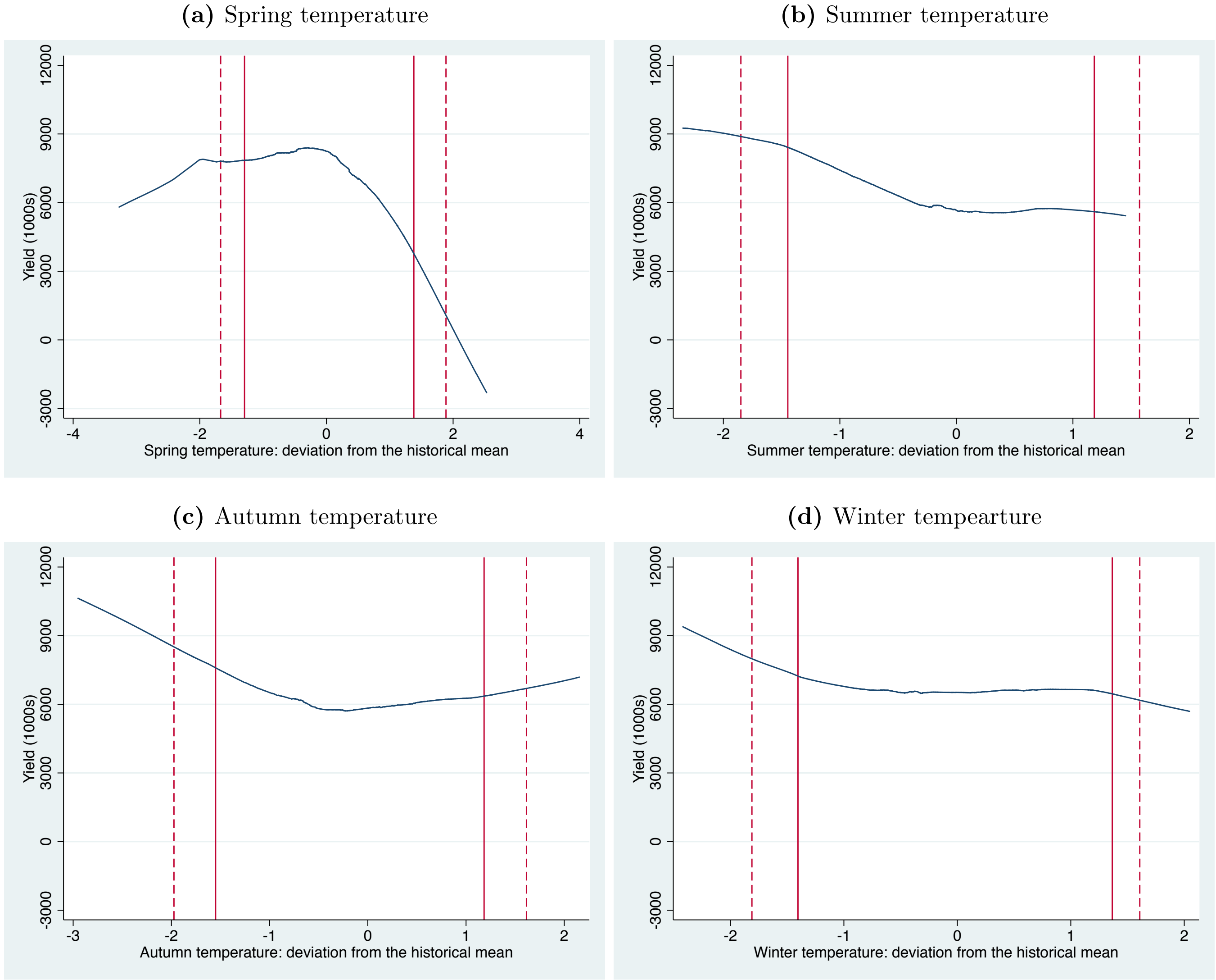



**(b)** Share of Jews among traders in grain across all localities during political turmoil and macro-economic shock



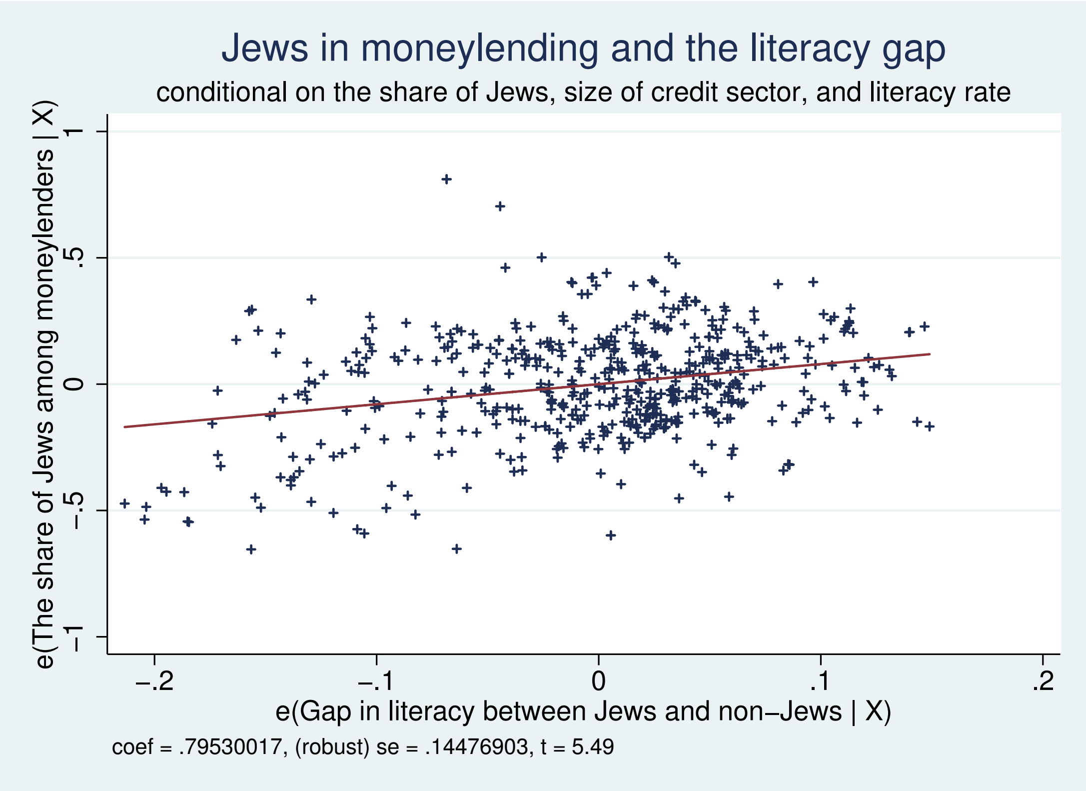

**Note:** The figure presents the frequency of occurrence of pogroms by quartiles of the share of Jews among moneylenders in grid cells that suffered from a negative agro-climatic shock at times of political turmoil (Panel A) and by quartiles of the share of Jews among traders in grain in all grid cells during political turmoil which coincided with occurrence of crop failures in provinces of the Pale, most suitable for grain cultivation, in the same or in the previous year (Panel B).

**Figure 4:** Seasonal temperature shocks and grain yield




**Note:** The figure presents non-parametric locally-weighted regressions (LOWESS) conditional on province and year fixed effects between grain yield at the province level between 1862 and 1914 and the deviation of seasonal temperature from historical mean for each season across provinces in the Pale of Settlement. Spring is defined as the second quarter. From left to right, the dashed vertical lines indicate the 5th and the 95th percentiles of the distribution of deviation of spring temperature from the historical mean and solid vertical lines indicate the 10th and the 90th percentiles of this distribution. The top and the bottom 0.5% of the distribution of the temperature deviation are excluded.

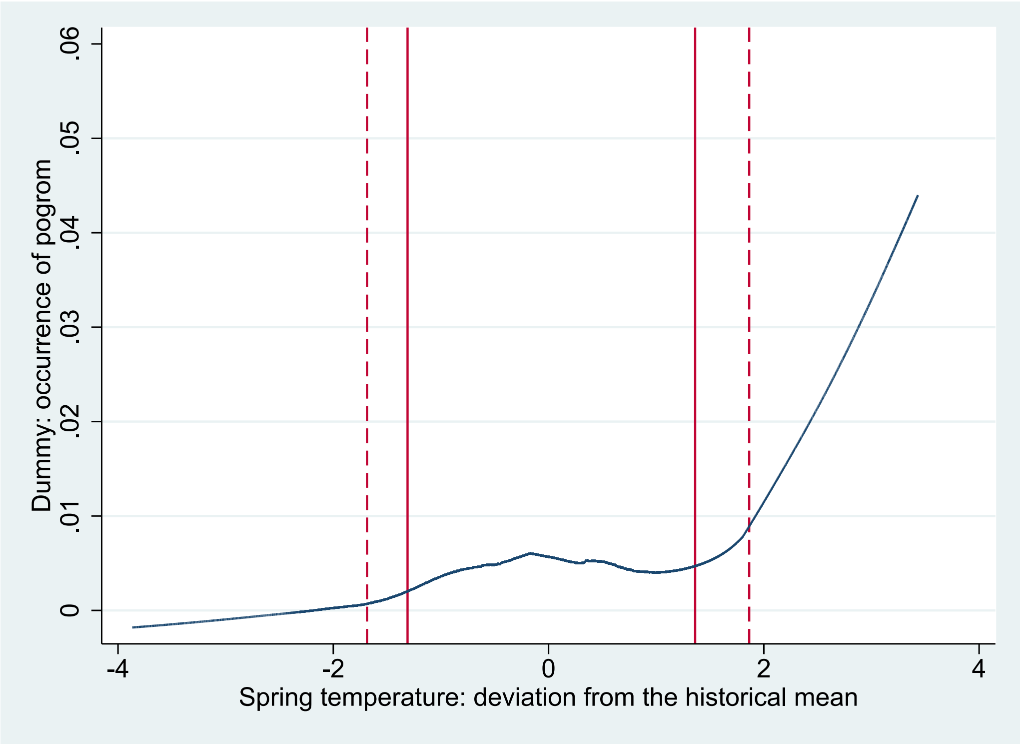
**Figure 5:** Visualisation of the first stage



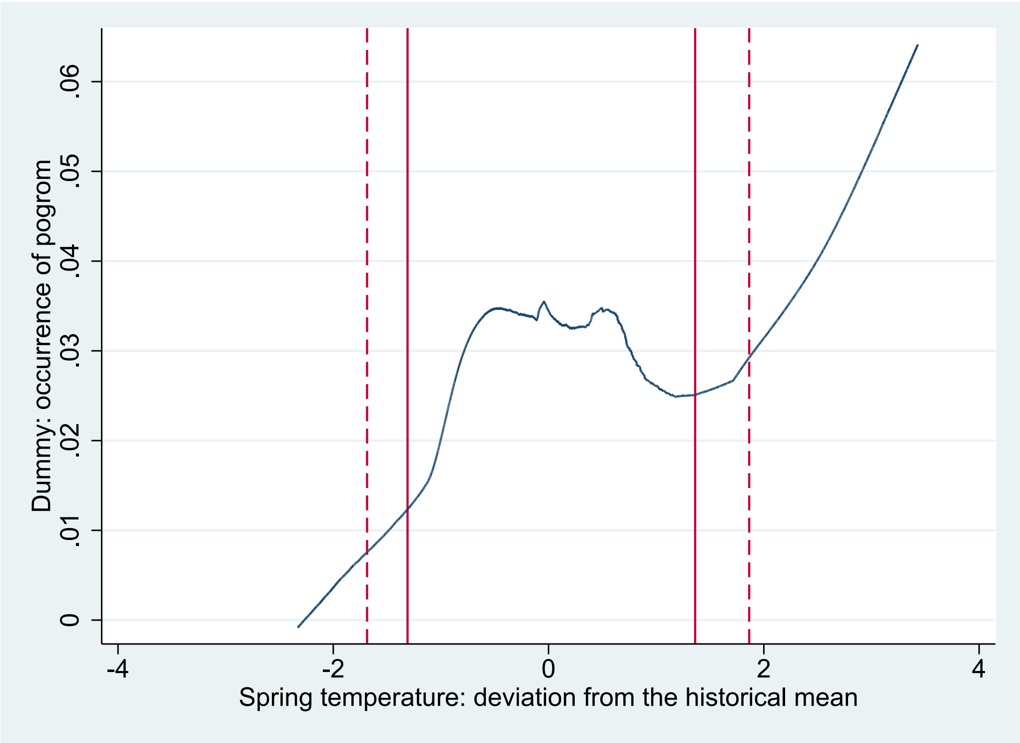

**Note:** The figure presents the conditional scatter plot, in which the share of Jews in moneylending is related to the gap in literacy between Jews and non-Jews in both the native language and in Russian conditional on the share of Jews, the share of credit in total employment, and total literacy rate.

**Figure 6:** Pogroms, local economic shocks, and political turmoil

**(a)** The whole sample




**(b)** Years of political turmoil




**Note:** The figure presents unconditional non-parametric locally-weighted regressions (LOWESS) between pogrom occurrence in a grid cell and year and the deviation of spring temperature in a grid cell and year from historical mean. Panel A presents this relationship for for the entire observation period, 1800-1927, and Panel B for the years of political turmoil. Spring is defined as the second quarter. From left to right, the dashed vertical lines indicate the 5th and the 95th percentiles of the distribution of deviation of spring temperature from the historical mean and solid vertical lines indicate the 10th and the 90th percentiles of this distribution. The top and the bottom 0.5% of the distribution of the temperature deviation are excluded.

**Table 1:** Summary statistics: pogroms, Jewish occupations, and literacy in the Pale

| Variable | Mean | Std. Dev. | Min. | Max. | N |
|---|---|---|---|---|---|
| **Panel A: The share of Jews in local population & in local occupations across grid cells** | | | | | |
| Share of Jews in population | 0.1031 | 0.0511 | 0.0089 | 0.2488 | 576 |
| Share of Jews in moneylending | 0.5378 | 0.2837 | 0 | 1 | 576 |
| Share of Jews in trade | 0.7994 | 0.2089 | 0.0637 | 0.9883 | 576 |
| Share of Jews in agricultural trade | 0.8116 | 0.2065 | 0.0461 | 0.9946 | 576 |
| Share of Jews in grain trade | 0.8791 | 0.1838 | 0 | 1 | 576 |
| Share of Jews in non-agricultural trade | 0.8198 | 0.1979 | 0.0871 | 0.9934 | 576 |
| Share of Jews in crafts/industry | 0.4813 | 0.208 | 0.0354 | 0.8409 | 576 |
| Share of Jews in transport | 0.3508 | 0.2091 | 0.0029 | 0.9134 | 576 |
| Share of Jews in agriculture | 0.0068 | 0.0065 | 0.0001 | 0.0415 | 576 |
| **Panel C: Pogroms across grid cell × year observations** | | | | | |
| Pogrom occurrence | 0.0050 | 0.0709 | 0 | 1 | 73728 |
| Pogrom occurrence in agricultural season | 0.0032 | 0.0564 | 0 | 1 | 73728 |
| Pogrom occurrence in harvest period | 0.0014 | 0.0379 | 0 | 1 | 73728 |
| Pogrom occurrence in non-agricultural season | 0.0015 | 0.0386 | 0 | 1 | 73728 |
| Pogrom occurrence in unknown season | 0.0006 | 0.0241 | 0 | 1 | 73728 |
| Number of pogroms | 0.0084 | 0.1659 | 0 | 20 | 73728 |
| Number of pogroms in agricultural season | 0.0055 | 0.142 | 0 | 19 | 73728 |
| Number of pogroms in harvest period | 0.0020 | 0.0624 | 0 | 7 | 73728 |
| Number of pogroms in non-agricultural season | 0.0022 | 0.0574 | 0 | 4 | 73728 |
| Number of pogroms in unknown season | 0.0007 | 0.0317 | 0 | 3 | 73728 |
| **Panel B: Literacy of Jews and of non-Jews across grid cells** | | | | | |
| Total literacy rate | 0.2206 | 0.0853 | 0.0695 | 0.4849 | 576 |
| Literacy rate of Jews | 0.4045 | 0.0827 | 0.1649 | 0.5842 | 576 |
| Literacy rate of non-Jews | 0.2014 | 0.0948 | 0.0498 | 0.4928 | 576 |
| Gap in literacy between Jews and non-Jews | 0.2031 | 0.1218 | -0.1419 | 0.4396 | 576 |

**Table 2:** Local temperature shocks and grain yield

| | Grain yield: 1862–1914 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A: Local temperature shock: dummy variable** | | | | | | | | |
| hot spring | -3,342*** | | | | | | | -3,535*** |
| | (895) | | | | | | | (943) |
| cold spring | | -1,137 | | | | | | -1,082 |
| | | (785) | | | | | | (723) |
| cold summer | | | -994 | | | | | -1,020 |
| | | | (929) | | | | | (939) |
| hot autumn | | | | 902 | | | | 1,589 |
| | | | | (1,495) | | | | (1,536) |
| cold autumn | | | | | 452 | | | 490 |
| | | | | | (540) | | | (563) |
| hot winter | | | | | | -590 | | -379 |
| | | | | | | (1,519) | | (1,507) |
| cold winter | | | | | | | 367 | 124 |
| | | | | | | | (1,494) | (1,394) |
| R-squared | 0.636 | 0.628 | 0.628 | 0.628 | 0.628 | 0.628 | 0.628 | 0.639 |
| **Panel B: Local temperature shock: continuous variable** | | | | | | | | |
| dev spring temperature | -1,236*** | | | | | | | -1,077*** |
| | (385) | | | | | | | (372) |
| dev summer temperature | | | -1,454*** | | | | | -1,358*** |
| | | | (417) | | | | | (407) |
| dev autumn temperature | | | | | -10 | | | 97 |
| | | | | | (413) | | | (394) |
| dev winter temperature | | | | | | | -392 | -205 |
| | | | | | | | (376) | (397) |
| R-squared | 0.634 | | 0.637 | | 0.628 | | 0.628 | 0.642 |
| Province FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 535 | 535 | 535 | 535 | 535 | 535 | 535 | 535 |
| Mean of dependent var. | 6697 | 6697 | 6697 | 6697 | 6697 | 6697 | 6697 | 6697 |
| s.d. of dependent var. | 4953 | 4953 | 4953 | 4953 | 4953 | 4953 | 4953 | 4953 |

**Note:** The unit of analysis is province × year. The table presents the impact of seasonal temperature shocks on grain yield between 1862 and 1914 at the province level. There are 15 provinces in the Pale of Settlement outside the Kingdom of Poland, for which yield data are not available. Panel A uses the dummies for extreme (below the 5th and above the 95th percentile) deviations of seasonal temperature in a province and year from its local historical means as a measure of seasonal local weather shocks and Panel B considers continuous measures, namely, the standardized deviations of seasonal temperatures in a province and year from their respective local historical means. Seasons are defined as follows: winter is the first quarter (i.e., January to March), spring is the second quarter, summer is the third and autumn is the fourth quarter. Standard errors are corrected for both spatial and temporal correlations following Hsiang (2010) in a radius of 250 km and 1 temporal lag. *** p<0.01, ** p<0.05, * p<0.1

**Table 3:** Grain prices, yields, local and macro temperature shocks

| | Log of price of rye: 1860–1915 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample: | All Pale Provinces | | | Suitable Pale provinces | | All Pale Provinces | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| log grain harvest | -0.0201** | | | | | | | |
| | (0.0099) | | | | | | | |
| hot spring | | 0.0346 | | 0.0631** | | | | |
| | | (0.0312) | | (0.0297) | | | | |
| hot spring lag | | 0.0729** | | 0.1045*** | | | | |
| | | (0.0296) | | (0.0259) | | | | |
| dev spring temp | | | 0.0157 | | 0.0385*** | | | |
| | | | (0.0110) | | (0.0128) | | | |
| dev spring temp lag | | | 0.0150 | | 0.0291* | | | |
| | | | (0.0114) | | (0.0148) | | | |
| macro-econ shock | | | | | | 0.0392* | | 0.0612** |
| | | | | | | (0.0216) | | (0.0268) |
| political turmoil | | | | | | | -0.0608*** | -0.0889*** |
| | | | | | | | (0.0209) | (0.0225) |
| macro-econ shock × political turmoil | | | | | | | | 0.0043 |
| | | | | | | | | (0.0412) |
| Year FE | Yes | Yes | Yes | Yes | Yes | No | No | No |
| Province FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 523 | 1,312 | 1,312 | 653 | 653 | 1,312 | 1,312 | 1,312 |
| R-squared | 0.823 | 0.734 | 0.735 | 0.756 | 0.763 | 0.186 | 0.190 | 0.204 |

**Note:** The unit of analysis is province × year. The table presents the impact of log of grain harvest, seasonal temperature shocks, macro-economic shocks, and political turmoil on log of price of rye between 1860 and 1915 at the province level. There are 24 provinces in the Pale of Settlement, 15 of which are outside the Kingdom of Poland. Yield data are unavailable for provinces inside the Kingdom of Poland and for the period before 1864. Standard errors are corrected for both spatial and temporal correlations following Hsiang (2010) in a radius of 250 km and 1 temporal lag. *** p<0.01, ** p<0.05, * p<0.1

**Table 4:** The timing of pogrom occurrence and local economic shocks and political turmoil

| | Pogrom occurrence | | Pogrom occurrence agri. season | Pogrom occurrence non-agri. season | Pogrom occurrence harvesting season | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: Local economic shock: dummy variable** | | | | | | |
| hot spring | 0.0120** | 0.0004 | 0.0005 | 0.0001 | -0.0001 | -0.0001 |
| | (0.0051) | (0.0007) | (0.0005) | (0.0002) | (0.0003) | (0.0003) |
| hot spring × political turmoil | | 0.0380** | 0.0316** | 0.0033 | 0.0152* | 0.0153* |
| | | (0.0159) | (0.0155) | (0.0029) | (0.0083) | (0.0083) |
| hot summer | | | | | | -0.0005* |
| | | | | | | (0.0003) |
| hot summer × political turmoil | | | | | | 0.0021 |
| | | | | | | (0.0048) |
| R-squared | 0.115 | 0.116 | 0.0857 | 0.0992 | 0.0426 | 0.0426 |
| **Panel B: Local economic shock: continuous variable** | | | | | | |
| dev spring temperature | 0.0048** | 0.0002 | -0.0000 | 0.0000 | -0.0000 | 0.0000 |
| | (0.0022) | (0.0002) | (0.0001) | (0.0001) | (0.0001) | (0.0001) |
| dev spring temp. × political turmoil | | 0.0196** | 0.0208** | -0.0030 | 0.0091** | 0.0096** |
| | | (0.0088) | (0.0083) | (0.0020) | (0.0046) | (0.0047) |
| dev summer temperature | | | | | | -0.0001 |
| | | | | | | (0.0001) |
| dev summer temp. × political turmoil | | | | | | -0.0053 |
| | | | | | | (0.0036) |
| R-squared | 0.116 | 0.117 | 0.0883 | 0.0993 | 0.0437 | 0.0445 |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Grid FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 |
| Mean of dependent var. | 0.00505 | 0.00505 | 0.00317 | 0.00149 | 0.00144 | 0.00144 |
| s.d. of dependent var. | 0.0709 | 0.0709 | 0.0562 | 0.0386 | 0.0379 | 0.0379 |

**Note:** The unit of analysis is grid cell × year. Dependent variable is a dummy variable that takes the value of 1 if a pogrom occurred in a given year and grid cell, and 0 otherwise. The table presents results of regressions in which the probability of pogrom in a grid cell and year is related to the local economic shocks and political turmoil controlling for year and grid cell fixed effects. In Panel A, the local economic shock is measured by a dummy "hot spring" defined as a the top five percent of the standardized deviation of spring temperature from the grid-cell-specific historical rolling 75-year mean. In Panel B, the local economic shock is measured as the standardized deviation of spring temperature from the grid-cell-specific historical rolling 75-year mean. Agricultural season is defined as April to September. Non-agricultural season is defined as October to March. Spring (i.e., the planting and early growing season) is defined as April, May, and June. Harvesting season is defined as July, August, and September. Standard errors are corrected for both spatial and temporal correlations following Hsiang (2010) in a radius of 100 km and 1 temporal lag. *** p<0.01, ** p<0.05, * p<0.1

**Table 5:** Specialization of Jews in moneylending and pogrom occurrence during local economic shocks and political turmoil, OLS

| | Pogrom occurrence | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| **Panel A: Local economic shock: dummy variable** | | | | |
| hot spring | 0.0004 | 0.0007 | 0.0007 | 0.0003 |
| | (0.0007) | (0.0010) | (0.0008) | (0.0010) |
| hot spring × political turmoil | 0.0380** | -0.0063 | -0.0134 | -0.0257 |
| | (0.0159) | (0.0247) | (0.0207) | (0.0279) |
| hot spring × share of Jews | | -0.0010 | | 0.0048 |
| | | (0.0070) | | (0.0082) |
| political turmoil × share of Jews | | 0.0050 | | -0.0877 |
| | | (0.0448) | | (0.0561) |
| hot spring × political turmoil × share of Jews | | 0.3905** | | 0.2860 |
| | | (0.1699) | | (0.1909) |
| hot spring × Jews in credit | | | 0.0002 | -0.0001 |
| | | | (0.0009) | (0.0009) |
| political turmoil × Jews in credit | | | -0.0022 | 0.0059 |
| | | | (0.0086) | (0.0099) |
| hot spring × political turmoil × Jews in credit | | | 0.0798*** | 0.0568** |
| | | | (0.0275) | (0.0228) |
| R-squared | 0.116 | 0.118 | 0.121 | 0.121 |
| **Panel B: Local economic shock: continuous variable** | | | | |
| dev spring temperature | 0.0002 | 0.0003 | 0.0003 | 0.0002 |
| | (0.0002) | (0.0002) | (0.0002) | (0.0002) |
| dev spring temp. × political turmoil | 0.0196** | 0.0187** | 0.0188** | 0.0186** |
| | (0.0088) | (0.0090) | (0.0089) | (0.0091) |
| dev spring temp. × share of Jews | | 0.0010 | | 0.0007 |
| | | (0.0017) | | (0.0013) |
| political turmoil × share of Jews | | 0.0423 | | -0.0571 |
| | | (0.0459) | | (0.0533) |
| dev spring temp. × political turmoil × share of Jews | | 0.0604 | | 0.0419 |
| | | (0.0485) | | (0.0555) |
| dev spring temp. × Jews in credit | | | 0.0001 | 0.0001 |
| | | | (0.0002) | (0.0002) |
| political turmoil × Jews in credit | | | 0.0043 | 0.0094 |
| | | | (0.0085) | (0.0093) |
| dev spring temp. × political turmoil × Jews in credit | | | 0.0166** | 0.0133** |
| | | | (0.0078) | (0.0065) |
| R-squared | 0.117 | 0.118 | 0.120 | 0.121 |
| Year FE | Yes | Yes | Yes | Yes |
| Grid FE | Yes | Yes | Yes | Yes |
| Local economic shock | Yes | Yes | Yes | Yes |
| Size of credit sector interactions | No | No | Yes | Yes |
| Observations | 73,728 | 73,728 | 73,728 | 73,728 |
| Mean of dependent var. | 0.00505 | 0.00505 | 0.00505 | 0.00505 |
| s.d. of dependent var. | 0.0709 | 0.0709 | 0.0709 | 0.0709 |

**Note:** The unit of analysis is grid cell × year. Dependent variable is a dummy variable that takes the value of 1 if a pogrom occurred in a given year and grid cell, and 0 otherwise. The table presents OLS regressions results in which the probability of pogrom in a grid cell and year is related to the local economic shocks and political turmoil, the presence of Jews, and the share of Jews among moneylenders, controlling for year and grid cell fixed effects. In Panel A, economic shock is measured by a dummy "hot spring" defined as a the top five percent of the sample according to the standardized deviation of spring temperature from the grid-cell-specific historical rolling 75-year mean of spring temperature. In Panel B, economic shock is measured as the standardized deviation of spring temperature from the grid-cell-specific historical rolling 75-year mean of spring temperature. All continuous variables are demeaned before taking interactions in Panel B. "Jews in credit" denotes the local share of Jews among moneylenders. Spring is defined as April, May, and June. Standard errors are corrected for both spatial and temporal correlations following Hsiang (2010) in a radius of 100 km and 1 temporal lag. *** p<0.01, ** p<0.05, * p<0.1

**Table 6:** Instrumental variable estimation: Specialization of Jews in moneylending and pogrom occurrence during local economic shocks and political turmoil, 2SLS

| | First stage | | | Occurrence of pogroms | | |
|---|---|---|---|---|---|---|
| | econ. shock × Jews in credit | pol. turmoil × Jews in credit | econ. shock × pol. turmoil × Jews in credit | OLS | IV | IV |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: Local economic shock: dummy variable** | | | | | | |
| hot spring × literacy gap Jews/non-Jews | 0.9047*** | -0.0137 | -0.0010 | | | |
| | (0.1485) | (0.0251) | (0.0040) | | | |
| pol. turmoil × literacy gap Jews/non-Jews | 0.0007 | 0.8000*** | 0.0011 | | | |
| | (0.0042) | (0.0639) | (0.0027) | | | |
| hot spring × pol. turmoil × literacy gap Jews/non-Jews | 0.0178 | 0.1282 | 0.9255*** | | | |
| | (0.2200) | (0.1558) | (0.1663) | | | |
| hot spring × Jews in credit | | | | -0.0001 | -0.0012 | -0.0017 |
| | | | | (0.0009) | (0.0039) | (0.0043) |
| pol. turmoil × Jews in credit | | | | 0.0059 | -0.0718 | -0.0867 |
| | | | | (0.0099) | (0.0501) | (0.0532) |
| hot spring × pol. turmoil × Jews in credit | | | | 0.0568** | 0.2623** | 0.2602* |
| | | | | (0.0228) | (0.1286) | (0.1356) |
| hot spring × share of Jews | 3.3880*** | 0.0422 | 0.0076 | 0.0048 | 0.0091 | 0.0105 |
| | (0.2224) | (0.0381) | (0.0067) | (0.0082) | (0.0129) | (0.0137) |
| pol. turmoil × share of Jews | -0.0024 | 3.7217*** | -0.0002 | -0.0877 | 0.1541 | 0.1886 |
| | (0.0068) | (0.0903) | (0.0045) | (0.0561) | (0.1692) | (0.1775) |
| hot spring × pol. turmoil × share of Jews | 0.3131 | -0.0584 | 3.6918*** | 0.2860 | -0.2306 | -0.2163 |
| | (0.3432) | (0.2468) | (0.2679) | (0.1909) | (0.3574) | (0.3791) |
| hot spring × total literacy rate | -0.2144 | -0.0024 | 0.0002 | | -0.0035 | -0.0032 |
| | (0.1797) | (0.0306) | (0.0050) | | (0.0056) | (0.0056) |
| pol. turmoil × total literacy rate | 0.0008 | -0.2284*** | 0.0024 | | -0.2286*** | -0.2292*** |
| | (0.0057) | (0.0771) | (0.0036) | | (0.0729) | (0.0721) |
| hot spring × pol. turmoil × total literacy rate | 0.0817 | 0.0950 | -0.1302 | | 0.1363 | 0.1369 |
| | (0.2656) | (0.1887) | (0.2008) | | (0.1656) | (0.1664) |
| R-squared | 0.903 | 0.894 | 0.899 | 0.121 | | |
| F-stat | 23.26 | 62.38 | 10.79 | | 10.11 | 9.46 |
| **Panel B: Local economic shock: continuous variable** | | | | | | |
| dev spring temp. × literacy gap Jews/non-Jews | 0.7788*** | -0.0023 | -0.0007 | | | |
| | (0.0476) | (0.0044) | (0.0016) | | | |
| pol. turmoil × literacy gap Jews/non-Jews | -0.0270 | 0.8203*** | -0.0164 | | | |
| | (0.0679) | (0.0617) | (0.0624) | | | |
| dev spring temp. × pol. turmoil × literacy gap Jews/non-Jews | 0.1499 | 0.0088 | 0.9284*** | | | |
| | (0.1255) | (0.0471) | (0.1148) | | | |
| dev spring temp. × Jews in credit | | | | 0.0001 | -0.0012 | -0.0014 |
| | | | | (0.0002) | (0.0012) | (0.0014) |
| pol. turmoil × Jews in credit | | | | 0.0094 | -0.0379 | -0.0534 |
| | | | | (0.0093) | (0.0424) | (0.0459) |
| dev spring temp. × pol. turmoil × Jews in credit | | | | 0.0133** | 0.0606* | 0.0622* |
| | | | | (0.0065) | (0.0320) | (0.0339) |
| dev spring temp. × share of Jews | 3.7152*** | 0.0032 | 0.0009 | 0.0007 | 0.0045 | 0.0050 |
| | (0.0687) | (0.0061) | (0.0021) | (0.0013) | (0.0039) | (0.0043) |
| pol. turmoil × share of Jews | 0.0067 | 3.7431*** | -0.0176 | -0.0571 | 0.0989 | 0.1350 |
| | (0.0918) | (0.0878) | (0.0841) | (0.0533) | (0.1442) | (0.1537) |
| dev spring temp. × pol. turmoil × share of Jews | -0.0528 | -0.0349 | 3.6652*** | 0.0419 | -0.0733 | -0.0773 |
| | (0.2018) | (0.0723) | (0.1872) | (0.0555) | (0.0920) | (0.0980) |
| dev spring temp. × total literacy rate | -0.2539*** | -0.0010 | -0.0002 | | -0.0013 | -0.0013 |
| | (0.0566) | (0.0052) | (0.0019) | | (0.0016) | (0.0016) |
| pol. turmoil × total literacy rate | -0.0345 | -0.2043*** | -0.0298 | | -0.1902*** | -0.1913*** |
| | (0.0822) | (0.0746) | (0.0756) | | (0.0640) | (0.0632) |
| dev spring temp. × pol. turmoil × total literacy rate | 0.1691 | -0.0070 | -0.0845 | | 0.0094 | 0.0104 |
| | (0.1565) | (0.0582) | (0.1443) | | (0.0439) | (0.0444) |
| R-squared | 0.493 | 0.894 | 0.480 | 0.121 | | |
| F-stat | 111 | 63.53 | 22.61 | | 9.65 | 9.07 |
| Local economic shock, Grid and Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Urbanization level interactions | No | No | No | No | No | Yes |
| Historical capital city interactions | Yes | Yes | Yes | No | Yes | Yes |
| Observations | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 |
| Mean of dependent var. | 0.538 | 0.538 | 0.538 | 0.00505 | 0.00505 | 0.00505 |
| SD of dependent var. | 0.283 | 0.283 | 0.283 | 0.0709 | 0.0709 | 0.0709 |

**Note:** The unit of analysis is grid cell × year. Dependent variable is a dummy variable that takes the value of 1 if a pogrom occurred in a given year and grid cell, and 0 otherwise. The table presents the results of IV regressions in which the probability of pogrom in a grid cell and year is related to the local economic shocks and political turmoil, the presence of Jews, and the share of Jews among moneylenders, controlling for year and grid cell fixed effects. The share of Jews among moneylenders is instrumented by the gap in literacy between Jews and Gentiles. In Panel A, local economic shock is measured by a dummy "hot spring" defined as a the top five percent of the standardized deviation of spring temperature from the grid-cell-specific historical rolling 75-year mean. In Panel B, local economic shock is measured as the standardized deviation of spring temperature from the grid-cell-specific historical rolling 75-year mean. All continuous variables are demeaned before taking interactions in Panel B. "Jews in credit" denotes the local share of Jews among moneylenders. Spring is defined as April, May, and June. Standard errors are corrected for both spatial and temporal correlations following Hsiang (2010) in a radius of 100 km and 1 temporal lag. *** p<0.01, ** p<0.05, * p<0.1

## Table 7: Specialization of Jews in trade in grain vs. other occupations, local economic shocks and political turmoil, OLS

| | Pogrom occurrence | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| **Panel A: Local economic shock: dummy variable** | | | | | |
| hot spring × Jews in grain trade | 0.0016 | | | | -0.0004 |
| | (0.0020) | | | | (0.0020) |
| political turmoil × Jews in grain trade | 0.0426*** | | | | 0.0512*** |
| | (0.0145) | | | | (0.0147) |
| hot spring × political turmoil × Jews in grain trade | -0.0304 | | | | -0.0246 |
| | (0.0328) | | | | (0.0358) |
| hot spring × Jews in non-agric. trade | | 0.0043* | | | 0.0028 |
| | | (0.0026) | | | (0.0024) |
| political turmoil × Jews in non-agric. trade | | 0.0143 | | | 0.0103 |
| | | (0.0164) | | | (0.0192) |
| hot spring × political turmoil × Jews in non-agric. trade | | -0.0501 | | | -0.0528 |
| | | (0.0361) | | | (0.0451) |
| hot spring × Jews in crafts/industry | | | 0.0026 | | 0.0027 |
| | | | (0.0028) | | (0.0029) |
| political turmoil × Jews in crafts/industry | | | -0.0777*** | | -0.0838*** |
| | | | (0.0251) | | (0.0270) |
| hot spring × political turmoil × Jews in crafts/industry | | | 0.0570 | | 0.0726 |
| | | | (0.0583) | | (0.0696) |
| hot spring × Jews in transport | | | | 0.0008 | -0.0011 |
| | | | | (0.0017) | (0.0019) |
| political turmoil × Jews in transport | | | | -0.0210 | -0.0196 |
| | | | | (0.0132) | (0.0162) |
| hot spring × political turmoil × Jews in transport | | | | 0.0067 | 0.0170 |
| | | | | (0.0309) | (0.0365) |
| R-squared | 0.120 | 0.119 | 0.120 | 0.119 | 0.122 |
| **Panel B: Local economic shock: continuous variable** | | | | | |
| dev spring temp. × Jews in grain trade | -0.0001 | | | | -0.0003 |
| | (0.0004) | | | | (0.0003) |
| political turmoil × Jews in grain trade | 0.0374*** | | | | 0.0463*** |
| | (0.0142) | | | | (0.0140) |
| dev spring temp. × political turmoil × Jews in grain trade | -0.0025 | | | | 0.0027 |
| | (0.0100) | | | | (0.0105) |
| dev spring temp. × Jews in non-agric. trade | | 0.0001 | | | 0.0001 |
| | | (0.0006) | | | (0.0006) |
| political turmoil × Jews in non-agric. trade | | 0.0114 | | | 0.0089 |
| | | (0.0164) | | | (0.0184) |
| dev spring temp. × political turmoil × Jews in non-agric. trade | | -0.0156 | | | -0.0187 |
| | | (0.0124) | | | (0.0137) |
| dev spring temp. × Jews in crafts/industry | | | -0.0001 | | -0.0003 |
| | | | (0.0009) | | (0.0008) |
| political turmoil × Jews in crafts/industry | | | -0.0672*** | | -0.0727*** |
| | | | (0.0242) | | (0.0262) |
| dev spring temp. × political turmoil × Jews in crafts/industry | | | 0.0029 | | 0.0078 |
| | | | (0.0176) | | (0.0194) |
| dev spring temp. × Jews in transport | | | | 0.0004 | 0.0006 |
| | | | | (0.0005) | (0.0005) |
| political turmoil × Jews in transport | | | | -0.0197 | -0.0181 |
| | | | | (0.0127) | (0.0155) |
| dev spring temp. × political turmoil × Jews in transport | | | | -0.0029 | 0.0016 |
| | | | | (0.0094) | (0.0106) |
| R-squared | 0.119 | 0.119 | 0.120 | 0.119 | 0.121 |
| The share of Jews interactions | Yes | Yes | Yes | Yes | Yes |
| Jews in credit interactions | Yes | Yes | Yes | Yes | Yes |
| Local economic shocks, Grid and Year FE | Yes | Yes | Yes | Yes | Yes |
| Observations | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 |
| Mean of dependent var. | 0.00505 | 0.00505 | 0.00505 | 0.00505 | 0.00505 |
| s.d. of dependent var. | 0.0709 | 0.0709 | 0.0709 | 0.0709 | 0.0709 |

**Note:** The unit of analysis is grid cell × year. Dependent variable is a dummy variable that takes the value of 1 if a pogrom occurred in a given year and grid cell, and 0 otherwise. The table presents OLS regressions results in which the probability of pogrom in a grid cell and year is related to the local economic shocks and political turmoil and the share of Jews in employment of different occupations, controlling for year and grid cell fixed effects and the interactions of the share of Jews and the share of Jews among moneylenders with economic and political shocks. "Jews in grain trade" denotes the local share of Jews among traders in grain. The shares of Jews in other occupations are denoted using the same principle. Standard errors are corrected for both spatial and temporal correlations following Hsiang (2010) in a radius of 100 km and 1 temporal lag. *** p<0.01, ** p<0.05, * p<0.1

**Table 8:** Specialization of Jews in trade in grain vs. other occupations, macro-economic shocks and political turmoil, OLS

| | Pogrom occurrence | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| **Panel A: Macro-economic and political turmoil shocks separately** | | | | | |
| macro-econ shock × Jews in grain trade | -0.0004 | | | | 0.0000 |
| | (0.0013) | | | | (0.0009) |
| political turmoil × Jewish share in grain trade | 0.0074 | | | | 0.0185 |
| | (0.0114) | | | | (0.0136) |
| macro-econ shock × political turmoil × Jews in grain trade | 0.0621** | | | | 0.0615** |
| | (0.0262) | | | | (0.0270) |
| macro-econ shock × Jews in non-agric. trade | | -0.0010 | | | -0.0006 |
| | | (0.0021) | | | (0.0017) |
| political turmoil × Jewish share in non-agric. trade | | -0.0114 | | | -0.0060 |
| | | (0.0132) | | | (0.0171) |
| macro-econ shock × political turmoil × Jews in non-agric. trade | | 0.0380 | | | 0.0181 |
| | | (0.0300) | | | (0.0351) |
| macro-econ shock × Jews in crafts/industry | | | -0.0010 | | -0.0005 |
| | | | (0.0028) | | (0.0024) |
| political turmoil × Jewish share in industry | | | -0.0562*** | | -0.0544*** |
| | | | (0.0191) | | (0.0202) |
| macro-econ shock × political turmoil × Jews in crafts/industry | | | -0.0221 | | -0.0348 |
| | | | (0.0463) | | (0.0501) |
| macro-econ shock × Jews in transport | | | | -0.0010 | -0.0007 |
| | | | | (0.0014) | (0.0012) |
| political turmoil × Jewish share in transport | | | | -0.0189 | -0.0087 |
| | | | | (0.0115) | (0.0129) |
| macro-econ shock × political turmoil × Jews in credit | | | | -0.0033 | -0.0170 |
| | | | | (0.0237) | (0.0292) |
| macro-econ shock × Jews in credit | -0.0006 | -0.0004 | -0.0003 | -0.0004 | -0.0001 |
| | (0.0009) | (0.0007) | (0.0006) | (0.0008) | (0.0005) |
| political turmoil × Jewish share in credit | -0.0166** | -0.0124 | 0.0000 | -0.0096 | 0.0006 |
| | (0.0077) | (0.0083) | (0.0075) | (0.0087) | (0.0083) |
| macro-econ shock × political turmoil × Jews in credit | -0.0067 | -0.0053 | 0.0106 | 0.0064 | 0.0024 |
| | (0.0200) | (0.0206) | (0.0224) | (0.0187) | (0.0219) |
| hot spring × Jewish share in credit × political turmoil | 0.0694** | 0.0660** | 0.0647** | 0.0623** | 0.0716** |
| | (0.0295) | (0.0295) | (0.0295) | (0.0293) | (0.0294) |
| R-squared | 0.120 | 0.118 | 0.120 | 0.118 | 0.122 |
| **Panel B: Macro-economic and political turmoil shocks together** | | | | | |
| macro-econ shock × political turmoil × Jews in grain trade | 0.0685*** | | | | 0.0785*** |
| | (0.0236) | | | | (0.0233) |
| macro-econ shock × political turmoil × Jews in non-agric. trade | | 0.0267 | | | 0.0122 |
| | | (0.0269) | | | (0.0308) |
| macro-econ shock × political turmoil × Jews in crafts/industry | | | -0.0744* | | -0.0849* |
| | | | (0.0423) | | (0.0459) |
| macro-econ shock × political turmoil × Jews in transport | | | | -0.0214 | -0.0255 |
| | | | | (0.0211) | (0.0265) |
| macro-econ shock × political turmoil × Jews in credit | -0.0224 | -0.0170 | 0.0103 | -0.0028 | 0.0029 |
| | (0.0185) | (0.0190) | (0.0212) | (0.0167) | (0.0203) |
| hot spring × Jewish share in credit × political turmoil | 0.0702** | 0.0669** | 0.0655** | 0.0633** | 0.0721** |
| | (0.0294) | (0.0294) | (0.0294) | (0.0292) | (0.0293) |
| R-squared | 0.119 | 0.118 | 0.119 | 0.118 | 0.121 |
| The share of Jews interactions | Yes | Yes | Yes | Yes | Yes |
| Grid and Year FE | Yes | Yes | Yes | Yes | Yes |
| Observations | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 |
| Mean of dependent var. | 0.00505 | 0.00505 | 0.00505 | 0.00505 | 0.00505 |
| s.d. of dependent var. | 0.0709 | 0.0709 | 0.0709 | 0.0709 | 0.0709 |

**Note:** The unit of analysis is grid cell × year. Dependent variable is a dummy variable that takes the value of 1 if a pogrom occurred in a given year and grid cell, and 0 otherwise. The table presents OLS regressions results in which the probability of pogrom in a grid cell and year is related to the macro-economic shocks and political turmoil and the share of Jews in employment of different occupations, controlling for year and grid cell fixed effects and the interactions of the share of Jews and the share of Jews among moneylenders with macro-economic and political shocks. "Jews in grain trade" denotes the local share of Jews among traders in grain. The shares of Jews in other occupations are denoted using the same principle. Standard errors are corrected for both spatial and temporal correlations following Hsiang (2010) in a radius of 100 km and 1 temporal lag. *** p<0.01, ** p<0.05, * p<0.1

**Table 9:** Pogroms and the number of Jews in grain trade

| | Pogrom occurrence | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| macro-econ shock × political turmoil × log number of Jews in grain trade | 0.0163** | 0.0165** | | |
| | (0.0067) | (0.0066) | | |
| log grain price × political turmoil × log number of Jews in grain trade | | | 0.1239*** | 0.1097*** |
| | | | (0.0382) | (0.0390) |
| macro-econ shock × political turmoil × share of Jews | -0.0089 | -0.1229 | | |
| | (0.1116) | (0.1708) | | |
| macro-econ shock × political turmoil × log total population | -0.0078 | -0.0077 | | |
| | (0.0050) | (0.0050) | | |
| macro-econ shock × political turmoil × Jews in credit | | 0.0295 | | |
| | | (0.0188) | | |
| macro-econ shock × political turmoil × Jews in non-agric. trade | | 0.0291 | | |
| | | (0.0335) | | |
| macro-econ shock × political turmoil × Jews in crafts/industry | | 0.0005 | | |
| | | (0.0476) | | |
| macro-econ shock × political turmoil × Jews in transport | | -0.0092 | | |
| | | (0.0293) | | |
| log grain price × political turmoil × share of Jews | | | -2.2845*** | -0.6574 |
| | | | (0.7529) | (1.2957) |
| log grain price × political turmoil × log total population | | | -0.0717** | -0.0598* |
| | | | (0.0301) | (0.0327) |
| log grain price × political turmoil × Jews in credit | | | | 0.0545 |
| | | | | (0.1402) |
| log grain price × political turmoil × Jews in non-agric. trade | | | | -0.0056 |
| | | | | (0.2706) |
| log grain price × political turmoil × Jews in crafts/industry | | | | -0.3398 |
| | | | | (0.3244) |
| log grain price × political turmoil × Jews in transport | | | | -0.3356** |
| | | | | (0.1623) |
| Grid and Year FE | Yes | Yes | Yes | Yes |
| Interactions with political turmoil | Yes | Yes | Yes | Yes |
| Interactions with macro-econ shock | Yes | Yes | No | No |
| Interactions with log grain price | No | No | Yes | Yes |
| Observations | 73,728 | 73,728 | 31,225 | 31,225 |
| R-squared | 0.122 | 0.123 | 0.166 | 0.174 |
| Mean of dependent var. | 0.00505 | 0.00505 | 0.00740 | 0.00740 |
| s.d. of dependent var. | 0.0709 | 0.0709 | 0.0857 | 0.0857 |

**Note:** The unit of analysis is grid cell × year. Dependent variable is a dummy variable that takes the value of 1 if a pogrom occurred in a given year and grid cell, and 0 otherwise. Columns 1 and 2 present regressions on the full sample and columns 3 and 4 on the subsample of years 1860-1915, for which comparable price data are available. The regressions show the relationship between pogroms and the number of Jews in trade in grain interacted with macro-economic shocks or grain prices and political turmoil. Standard errors are corrected for both spatial and temporal correlations following Hsiang (2010) in a radius of 100 km and 1 temporal lag. *** p<0.01, ** p<0.05, * p<0.1

**Table 10:** Enforcement capacity of the state and pogrom determinants

| | Pogrom occurrence | | | |
|---|---|---|---|---|
| | Pre-1917 | Post-1917 | Pre-1917 | Post-1917 |
| | (1) | (2) | (3) | (4) |
| hot spring × political turmoil × Jews in credit | 0.0237* | 0.0650** | | |
| | (0.0140) | (0.0314) | | |
| macro-econ shock × political turmoil × log number of Jews in grain trade | | | 0.0184*** | 0.0124* |
| | | | (0.0044) | (0.0065) |
| hot spring × political turmoil | 0.0288 | -0.0754*** | | |
| | (0.0364) | (0.0291) | | |
| hot spring × political turmoil × share of Jews | -0.1928 | 0.6361** | | |
| | (0.2146) | (0.2497) | | |
| hot spring × political turmoil × share of credit | 37.4378 | -10.1306 | | |
| | (25.8552) | (17.2704) | | |
| macro-econ shock × political turmoil × share of Jews | | | -0.2613* | 0.1919 |
| | | | (0.1381) | (0.1523) |
| Grid and Year FE | Yes | Yes | Yes | Yes |
| Observations | 67,392 | 6,336 | 67,392 | 6,336 |
| R-squared | 0.138 | 0.189 | 0.143 | 0.185 |
| Mean of dependent var. | 0.00347 | 0.0218 | 0.00347 | 0.0218 |
| s.d. of dependent var. | 0.0588 | 0.146 | 0.0588 | 0.146 |

**Note:** The unit of analysis is grid cell × year. Dependent variable is a dummy variable that takes the value of 1 if a pogrom occurred in a given year and grid cell, and 0 otherwise. All variables are defined as above. Columns 1 and 3 focus on the subsample before 1917 and columns 2 and 4 on the subsample after 1916. "Jews in credit" denotes the local share of Jews among moneylenders. Standard errors are corrected for both spatial and temporal correlations following Hsiang (2010) in a radius of 100 km and 1 temporal lag. *** p<0.01, ** p<0.05, * p<0.1

**Table 11:** Placebo: general crime, 1900-1912

| | Pale provinces | | | European provinces outside the Pale | | |
|---|---|---|---|---|---|---|
| | log theft | log homicide | log arson | log theft | log homicide | log arson |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| hot spring × political turmoil × Jews in credit | -0.2144 | -0.2524 | 4.0375*** | | | |
| | (0.2363) | (0.9800) | (0.3108) | | | |
| macro-econ shock × political turmoil × log Jews in grain trade | -0.1734 | 0.0723 | 0.2151 | | | |
| | (0.1788) | (0.3055) | (0.3551) | | | |
| hot spring × political turmoil × log number of creditors | -0.0494 | -0.0630 | 0.8199*** | -0.0057 | -0.0276 | 0.0892** |
| | (0.0857) | (0.2028) | (0.1729) | (0.0292) | (0.0345) | (0.0440) |
| macro-econ shock × political turmoil × log number of grain traders | 0.2171 | 0.0707 | -0.2239 | 0.0274 | -0.0129 | -0.0463 |
| | (0.1718) | (0.2822) | (0.3356) | (0.0257) | (0.0498) | (0.0615) |
| hot spring × political turmoil × share of Jews | 0.4535 | 0.9180 | -16.2423*** | | | |
| | (2.1297) | (2.4087) | (2.2187) | | | |
| hot spring × political turmoil | 0.2771 | 0.1719 | -5.8380*** | 0.0429 | 0.2495 | -0.4969* |
| | (0.5993) | (1.5266) | (1.2504) | (0.1824) | (0.2236) | (0.2857) |
| macro-econ shock × political turmoil × log total population | 0.0266 | 0.0108 | 0.2009 | 0.0268 | 0.2026** | 0.0375 |
| | (0.1438) | (0.2387) | (0.3396) | (0.0529) | (0.0955) | (0.1379) |
| Province FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 195 | 195 | 165 | 455 | 455 | 385 |
| R-squared | 0.920 | 0.851 | 0.889 | 0.957 | 0.841 | 0.928 |
| Mean of dependent var. | 6.061 | 3.969 | 4.998 | 5.800 | 3.725 | 4.551 |
| s.d. of dependent var. | 0.477 | 0.609 | 0.912 | 0.734 | 0.699 | 1.306 |

**Note:** The unit of analysis is province × year. The sample in the first three columns consists of 15 provinces in the Pale of Settlement and in the last three columns of 35 provinces in European part of the Russian Empire outside the Pale of Settlement between 1900 and 1912. "Jews in credit" denote the provincial share of Jews among moneylenders. "log Jews in grain trade" denote the provincial log number of Jewish traders in grain. Data on arson are not available for 1911 and 1912. Standard errors are corrected for both spatial and temporal correlations following Hsiang (2010) in a radius of 250 km and 1 temporal lag. *** p<0.01, ** p<0.05, * p<0.1

# A Online Appendix

**Table A1:** Summary statistics: occupational composition, climatic shocks, political turmoil, grain yield and other control variables

| Variable | Mean | Std. Dev. | Min. | Max. | N |
|---|---|---|---|---|---|
| **Panel A: Occupational composition and other controls across grid cells** | | | | | |
| Share of credit | 0.0004 | 0.0005 | 0 | 0.0039 | 576 |
| Share of trade | 0.0459 | 0.0176 | 0.0119 | 0.1372 | 576 |
| Share of agricultural trade | 0.0205 | 0.009 | 0.0055 | 0.0763 | 576 |
| Share of grain trade | 0.0049 | 0.0036 | 0 | 0.0181 | 576 |
| Share of non-agricultural trade | 0.0093 | 0.0043 | 0.0019 | 0.0309 | 576 |
| Share of crafts/industry | 0.0545 | 0.0272 | 0.0155 | 0.3377 | 576 |
| Share of transport | 0.0158 | 0.0115 | 0.0021 | 0.085 | 576 |
| Share of agriculture | 0.7239 | 0.1178 | 0.0387 | 0.9035 | 576 |
| Zero moneylenders dummy | 0.0122 | 0.1097 | 0 | 1 | 576 |
| Ancient capital dummy | 0.0156 | 0.1241 | 0 | 1 | 576 |
| Urbanization rate | 0.1310 | 0.1202 | 0.0213 | 0.9540 | 576 |
| **Panel B: Hot spring occurrence and political turmoil across grid cell × year obs.** | | | | | |
| Hot spring | 0.050 | 0.218 | 0 | 1 | 73728 |
| Political turmoil | 0.156 | 0.363 | 0 | 1 | 73728 |
| Hot spring during political turmoil | 0.024 | 0.153 | 0 | 1 | 73728 |
| **Panel C: Grain yield and climatic shocks across province × year obs.** | | | | | |
| Grain yield (in 1000s *tchetverds*) | 6697 | 4953 | 271 | 29718 | 535 |
| Hot spring | 0.062 | 0.241 | 0 | 1 | 535 |
| Cold spring | 0.030 | 0.170 | 0 | 1 | 535 |
| Hot summer | 0.004 | 0.061 | 0 | 1 | 535 |
| Cold summer | 0.050 | 0.219 | 0 | 1 | 535 |
| Hot autumn | 0.024 | 0.154 | 0 | 1 | 535 |
| Cold autumn | 0.114 | 0.318 | 0 | 1 | 535 |
| Hot winter | 0.054 | 0.227 | 0 | 1 | 535 |
| Cold winter | 0.050 | 0.219 | 0 | 1 | 535 |
| **Panel D: Grain price and climatic shocks across province × year obs.** | | | | | |
| Grain price (1860 constant prices) | 47.8984 | 10.8831 | 18.9598 | 114.137 | 1312 |
| Hot spring | 0.045 | 0.2073 | 0 | 1 | 1312 |
| **Panel E: Crime and climatic shocks across province × year obs.** | | | | | |
| Number of thefts | 453.7369 | 405.4413 | 23 | 3610 | 650 |
| Number of homicides | 54.5615 | 38.7514 | 2 | 285 | 650 |
| Number of arsons | 175.9145 | 159.6209 | 0 | 1009 | 550 |
| Hot spring | 0.0914 | 0.2884 | 0 | 1 | 689 |

**Table A2:** The main ethnicities in the Pale of Settlement

| Ethnicity | Number of people | Share, % of population |
|---|---|---|
| Ukranians | 15,966,632 | 37.4 |
| Poles | 7,700,340 | 18.0 |
| Belorussians | 5,976,801 | 14.0 |
| Jews | 4,809,057 | 11.2 |
| Russians | 3,359,755 | 7.88 |
| Lithuanians | 1,180,128 | 2.77 |
| Moldovans | 1,109,683 | 2.60 |
| Germans | 1,005,962 | 2.36 |
| Samogitians | 446,310 | 1.04 |
| Latvians | 311,303 | 0.73 |
| Tatars | 240,455 | 0.56 |
| Bulgars | 167,170 | 0.39 |
| Greeks | 77,860 | 0.18 |
| Turks | 63,927 | 0.15 |
| Other ethnicities | 172,648 | 0.40 |

**Source:** 1897 census of the Russian Empire

**Table A3:** The main occupations in the Pale of Settlement

| Occupation | Total population | | Jewish population | |
|---|---|---|---|---|
| | Number of people | Share, % of population | Number people | Share, % of Jews |
| Total population | 42,561,149 | 100 | 4,810,704 | 100 |
| Moneylending | 20,176 | 0.04 | 7,451 | 0.15 |
| Trade in grain | 234,434 | 0.55 | 216,377 | 4.49 |
| Trade in other agricultural products | 692,645 | 1.62 | 561,716 | 11.6 |
| Trade in non-agricultural goods | 433,723 | 1.01 | 365,442 | 7.59 |
| General trade | 453,242 | 1.06 | 376,495 | 7.82 |
| Other trade | 317,854 | 0.74 | 247,695 | 5.14 |
| Crafts/industry | 2,717,834 | 6.38 | 1,221,401 | 25.3 |
| Transport | 656,037 | 1.54 | 194,034 | 4.03 |
| Agriculture, husbandry, forests, and fishing | 29,739,371 | 69.8 | 186,782 | 3.88 |
| Private servants and blue collar workers | 2,515,777 | 5.91 | 322,087 | 6.69 |
| Processing woods and metals | 1,012,887 | 2.37 | 273,528 | 5.68 |
| Mining and smelting | 126,122 | 0.29 | 4,217 | 0.08 |
| Construction | 625,137 | 1.46 | 153,428 | 3.18 |
| Public administration | 994,434 | 2.33 | 47,134 | 0.97 |
| Liberal professions | 367,326 | 0.86 | 158,455 | 3.29 |
| Bars, hotels, restaurants, and clubs | 207,483 | 0.48 | 97,616 | 2.02 |
| Life on parents money or own financial income | 609,883 | 1.43 | 163,561 | 3.39 |
| Religious affairs | 249,661 | 0.58 | 86,128 | 1.79 |
| Other professions | 614,005 | 1.44 | 125,510 | 2.60 |

**Source:** 1897 census of the Russian Empire

**Table A4:** Local temperature shocks and log of grain yield

| | Log of grain yield: 1862–1914 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A: Local temperature shock: dummy variable** | | | | | | | | |
| hot spring | -0.229** | | | | | | | -0.212* |
| | (0.110) | | | | | | | (0.122) |
| cold spring | | -0.162 | | | | | | -0.163 |
| | | (0.106) | | | | | | (0.106) |
| cold summer | | | -0.076 | | | | | -0.096 |
| | | | (0.168) | | | | | (0.171) |
| hot autumn | | | | -0.002 | | | | 0.015 |
| | | | | (0.218) | | | | (0.229) |
| cold autumn | | | | | -0.089 | | | -0.081 |
| | | | | | (0.082) | | | (0.086) |
| hot winter | | | | | | -0.243 | | -0.218 |
| | | | | | | (0.188) | | (0.191) |
| cold winter | | | | | | | 0.088 | 0.095 |
| | | | | | | | (0.148) | (0.152) |
| R-squared | 0.593 | 0.592 | 0.592 | 0.591 | 0.592 | 0.593 | 0.592 | 0.596 |
| **Panel B: Local temperature shock: continuous variable** | | | | | | | | |
| dev spring temperature | -0.122** | | | | | | | -0.099** |
| | (0.050) | | | | | | | (0.049) |
| dev summer temperature | | | -0.108* | | | | | -0.102 |
| | | | (0.065) | | | | | (0.064) |
| dev autumn temperature | | | | | 0.049 | | | 0.057 |
| | | | | | (0.060) | | | (0.059) |
| dev winter temperature | | | | | | | -0.107** | -0.091* |
| | | | | | | | (0.049) | (0.050) |
| R-squared | 0.594 | | 0.594 | | 0.592 | | 0.593 | 0.598 |
| Province FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 535 | 535 | 535 | 535 | 535 | 535 | 535 | 535 |
| Mean of dependent var. | 15.47 | 15.47 | 15.47 | 15.47 | 15.47 | 15.47 | 15.47 | 15.47 |
| s.d. of dependent var. | 0.724 | 0.724 | 0.724 | 0.724 | 0.724 | 0.724 | 0.724 | 0.724 |

**Note:** The unit of analysis is province × year. The table presents the impact of seasonal temperature shocks on log of grain yield between 1862 and 1914 at the province level. The sample is restricted to provinces in the Pale of Settlement; there are 15 provinces in total. (Data for the provinces in the Kingdom of Poland are not available.) Panel A uses the dummies for extreme (below the 5th and above the 95th percentile) deviations of seasonal temperature in a province and year from its local historical means as a measure of seasonal local weather shocks and Panel B considers continuous measures, namely, the standardized deviations of seasonal temperatures in a province and year from their respective local historical means. Seasons are defined as follows: winter is the first quarter (i.e., January to March), spring is the second quarter, summer is the third and autumn is the fourth quarter. Standard errors are corrected for both spatial and temporal correlations following Hsiang (2010) in a radius of 250 km and 1 temporal lag. *** p<0.01, ** p<0.05, * p<0.1

**Table A5:** The robustness of the effect of the share of Jews among moneylenders to controlling for the shares of Jews in other occupations (OLS and IV)

| | Pogrom occurrence | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| **Panel A: OLS—Local economic shock: dummy variable** | | | | | |
| hot spring × Jews in credit | -0.0002 | -0.0005 | -0.0005 | -0.0000 | -0.0008 |
| | (0.0009) | (0.0009) | (0.0010) | (0.0009) | (0.0009) |
| political turmoil × Jews in credit | 0.0018 | -0.0034 | 0.0150 | 0.0036 | 0.0070 |
| | (0.0098) | (0.0100) | (0.0113) | (0.0095) | (0.0109) |
| hot spring × political turmoil × Jews in credit | 0.0598*** | 0.0653*** | 0.0438* | 0.0564** | 0.0513** |
| | (0.0228) | (0.0249) | (0.0238) | (0.0226) | (0.0244) |
| R-squared | 0.121 | 0.124 | 0.123 | 0.122 | 0.122 |
| **Panel B: OLS—Local economic shock: continuous variable** | | | | | |
| dev spring temp. × Jews in credit | 0.0000 | 0.0000 | 0.0001 | -0.0001 | -0.0000 |
| | (0.0002) | (0.0002) | (0.0002) | (0.0002) | (0.0002) |
| political turmoil × Jews in credit | 0.0058 | 0.0005 | 0.0162 | 0.0069 | 0.0089 |
| | (0.0092) | (0.0095) | (0.0107) | (0.0089) | (0.0103) |
| dev spring temp. × political turmoil × Jews in credit | 0.0135** | 0.0163** | 0.0130* | 0.0143** | 0.0155** |
| | (0.0064) | (0.0070) | (0.0066) | (0.0061) | (0.0068) |
| R-squared | 0.121 | 0.123 | 0.123 | 0.121 | 0.121 |
| **Panel C: 2SLS—Local economic shock: dummy variable** | | | | | |
| hot spring × Jews in credit | -0.0012 | 0.0001 | -0.0020 | -0.0009 | -0.0017 |
| | (0.0039) | (0.0033) | (0.0053) | (0.0032) | (0.0038) |
| political turmoil × Jews in credit | -0.0672 | -0.0496 | -0.0705 | -0.0606 | -0.0366 |
| | (0.0483) | (0.0382) | (0.0644) | (0.0387) | (0.0390) |
| hot spring × political turmoil × Jews in credit | 0.2586** | 0.2178** | 0.3142* | 0.2378** | 0.2433** |
| | (0.1276) | (0.1041) | (0.1691) | (0.1088) | (0.1235) |
| F-stat | 9.953 | 13.51 | 6.547 | 15.77 | 12.44 |
| **Panel D: 2SLS—Local economic shock: continuous variable** | | | | | |
| dev spring temp. × Jews in credit | -0.0012 | -0.0009 | -0.0017 | -0.0008 | -0.0008 |
| | (0.0012) | (0.0010) | (0.0016) | (0.0008) | (0.0009) |
| political turmoil × Jews in credit | -0.0341 | -0.0208 | -0.0332 | -0.0319 | -0.0072 |
| | (0.0408) | (0.0334) | (0.0541) | (0.0343) | (0.0340) |
| dev spring temp. × political turmoil × Jews in credit | 0.0596* | 0.0480* | 0.0837* | 0.0540** | 0.0583* |
| | (0.0318) | (0.0259) | (0.0453) | (0.0270) | (0.0321) |
| F-stat | 9.516 | 12.79 | 6.488 | 15.41 | 12.38 |
| Share of Jews in grain trade interactions | Yes | | | | Yes |
| Share of Jews in non-agr. trade interactions | | Yes | | | Yes |
| Share of Jews in crafts and industry interactions | | | Yes | | Yes |
| Share of Jews in transport interactions | | | | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes |
| Grid FE | Yes | Yes | Yes | Yes | Yes |
| Local economic shock | Yes | Yes | Yes | Yes | Yes |
| Observations | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 |

**Note:** The table reports the results of the specifications similar to those presented in column 4 of Table 5 and column 5 of Table 6 with additional controls for the interactions of local economic shocks and political turmoil with the shares of Jews in other occupations.

**Table A6:** The robustness of the effect of the share of Jews among moneylenders to alternative assumptions about the variance-covariance matrix (OLS and IV)

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Dependent variable: | Pogrom occurrence | | | | | | |
| Assumptions about VCV matrix: | Cluster | Conley spatial and over-time correlation | | | | | |
| | by grid cell | 50 km 1 lag | 100 km 1 lag | 200 km 1 lag | 100 km 2 lags | 100 km 3 lags | 200 km 3 lags |
| **Panel A: OLS—Local economic shock: dummy variable** | | | | | | | |
| hot spring × Jews in credit | -0.0001 | -0.0001 | -0.0001 | -0.0001 | -0.0001 | -0.0001 | -0.0001 |
| | (0.0005) | (0.0008) | (0.0009) | (0.0012) | (0.0009) | (0.0009) | (0.0012) |
| political turmoil × Jews in credit | 0.0059 | 0.0059 | 0.0059 | 0.0059 | 0.0059 | 0.0059 | 0.0059 |
| | (0.0073) | (0.0075) | (0.0099) | (0.0121) | (0.0099) | (0.0100) | (0.0122) |
| hot spring × political turmoil × Jews in credit | 0.0568*** | 0.0568*** | 0.0568** | 0.0568** | 0.0568** | 0.0568** | 0.0568** |
| | (0.0159) | (0.0183) | (0.0228) | (0.0271) | (0.0229) | (0.0229) | (0.0272) |
| R-squared | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 |
| **Panel B: OLS—Local economic shock: continuous variable** | | | | | | | |
| dev spring temp. × Jews in credit | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | (0.0001) | (0.0002) | (0.0002) | (0.0003) | (0.0002) | (0.0002) | (0.0003) |
| political turmoil × Jews in credit | 0.0094 | 0.0094 | 0.0094 | 0.0094 | 0.0094 | 0.0094 | 0.0094 |
| | (0.0069) | (0.0070) | (0.0093) | (0.0116) | (0.0093) | (0.0094) | (0.0116) |
| dev spring temp. × political turmoil × Jews in credit | 0.0133*** | 0.0133*** | 0.0133** | 0.0133* | 0.0133** | 0.0133** | 0.0133* |
| | (0.0048) | (0.0051) | (0.0065) | (0.0079) | (0.0065) | (0.0065) | (0.0080) |
| R-squared | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 | 0.121 |
| **Panel C: 2SLS—Local economic shock: dummy variable** | | | | | | | |
| hot spring × Jews in credit | -0.0012 | -0.0012 | -0.0012 | -0.0012 | -0.0012 | -0.0012 | -0.0012 |
| | (0.0021) | (0.0036) | (0.0042) | (0.0054) | (0.0042) | (0.0041) | (0.0053) |
| political turmoil × Jews in credit | -0.0718* | -0.0718** | -0.0718 | -0.0718 | -0.0718 | -0.0718 | -0.0718 |
| | (0.0385) | (0.0338) | (0.0440) | (0.0624) | (0.0445) | (0.0447) | (0.0635) |
| hot spring × political turmoil × Jews in credit | 0.2623*** | 0.2623*** | 0.2623** | 0.2623* | 0.2623** | 0.2623** | 0.2623* |
| | (0.0888) | (0.0889) | (0.1120) | (0.1391) | (0.1133) | (0.1146) | (0.1442) |
| **Panel D: 2SLS—Local economic shock: continuous variable** | | | | | | | |
| dev spring temp. × Jews in credit | -0.0012* | -0.0012 | -0.0012 | -0.0012 | -0.0012 | -0.0012 | -0.0012 |
| | (0.0007) | (0.0011) | (0.0012) | (0.0014) | (0.0012) | (0.0012) | (0.0015) |
| political turmoil × Jews in credit | -0.0379 | -0.0379 | -0.0379 | -0.0379 | -0.0379 | -0.0379 | -0.0379 |
| | (0.0351) | (0.0318) | (0.0417) | (0.0591) | (0.0422) | (0.0424) | (0.0599) |
| dev spring temp. × political turmoil × Jews in credit | 0.0606** | 0.0606*** | 0.0606** | 0.0606 | 0.0606* | 0.0606** | 0.0606 |
| | (0.0249) | (0.0230) | (0.0308) | (0.0410) | (0.0310) | (0.0308) | (0.0412) |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Grid FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 |

**Note:** This table reports the results of the specifications presented in column 4 of Table 5 and column 5 of Table 6 using alternative assumptions about variance-covariance matrix. *** p<0.01, ** p<0.05, * p<0.1

**Table A7:** The robustness of the effect of the share of Jews among grain traders to alternative assumptions about the variance-covariance matrix (OLS)

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Dependent variable: | Pogrom occurrence | | | | | | |
| Assumptions about VCV matrix: | Cluster | Conley spatial and over-time correlation | | | | | |
| | by grid cell | 50 km 1 lag | 100 km 1 lag | 200 km 1 lag | 100 km 2 lags | 100 km 3 lags | 200 km 3 lags |
| **Panel A: Macro-economic and political turmoil shocks separately** | | | | | | | |
| macro shock × Jews in grain trade | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| | (0.0004) | (0.0011) | (0.0012) | (0.0015) | (0.0012) | (0.0013) | (0.0015) |
| political turmoil × Jewish share in grain trade | 0.0075 | 0.0075 | 0.0075 | 0.0075 | 0.0075 | 0.0075 | 0.0075 |
| | (0.0099) | (0.0095) | (0.0114) | (0.0117) | (0.0114) | (0.0114) | (0.0116) |
| macro shock × political turmoil × Jews in grain trade | 0.0616*** | 0.0616*** | 0.0616** | 0.0616* | 0.0616** | 0.0616** | 0.0616* |
| | (0.0171) | (0.0193) | (0.0262) | (0.0331) | (0.0262) | (0.0262) | (0.0331) |
| R-squared | 0.120 | 0.120 | 0.120 | 0.120 | 0.120 | 0.120 | 0.120 |
| **Panel B: Macro-economic and political turmoil shocks together** | | | | | | | |
| macro econ and political shock × Jews in grain trade | 0.0685*** | 0.0685*** | 0.0685*** | 0.0685** | 0.0685*** | 0.0685*** | 0.0685** |
| | (0.0153) | (0.0168) | (0.0236) | (0.0310) | (0.0236) | (0.0236) | (0.0310) |
| R-squared | 0.119 | 0.119 | 0.119 | 0.119 | 0.119 | 0.119 | 0.119 |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Grid FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 | 73,728 |

**Note:** This table reports the results of the specifications presented in column 1 of Table 8 using alternative assumptions about variance-covariance matrix. *** p<0.01, ** p<0.05, * p<0.1

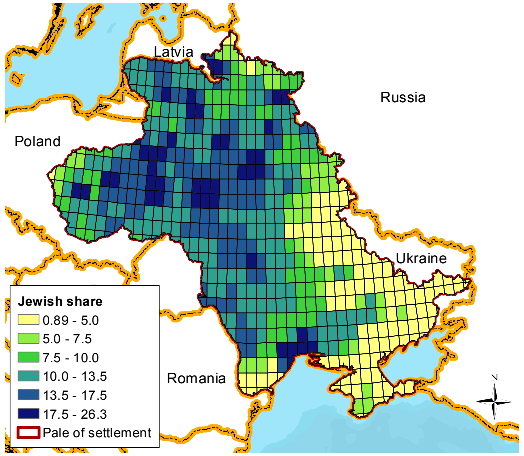
**Table A8:** Grain prices, yields, local and macro temperature shocks: European provinces of the Russian Empire outside the Pale

| | Log of grain harvest: 1864–1915 | | Log of price of rye: 1860–1915 | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| hot spring | -0.2084** | | | 0.0322 | | | | |
| | (0.0824) | | | (0.0207) | | | | |
| dev spring temp | | -0.0361 | | | 0.0148** | | | |
| | | (0.0230) | | | (0.0071) | | | |
| log grain harvest | | | -0.0667*** | | | | | |
| | | | (0.0116) | | | | | |
| hot spring lag | | | | 0.0470 | | | | |
| | | | | (0.0327) | | | | |
| dev spring temp lag | | | | | 0.0259*** | | | |
| | | | | | (0.0071) | | | |
| macro-econ shock | | | | | | 0.1222*** | | 0.1300*** |
| | | | | | | (0.0168) | | (0.0199) |
| political turmoil | | | | | | | 0.0268 | -0.0260 |
| | | | | | | | (0.0201) | (0.0177) |
| macro-econ shock × political turmoil | | | | | | | | -0.0026 |
| | | | | | | | | (0.0350) |
| Year FE | Yes | Yes | Yes | Yes | Yes | No | No | No |
| Province FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,214 | 1,214 | 1,191 | 1,916 | 1,916 | 1,916 | 1,916 | 1,916 |
| R-squared | 0.007 | 0.827 | 0.817 | 0.812 | 0.815 | 0.460 | 0.427 | 0.461 |

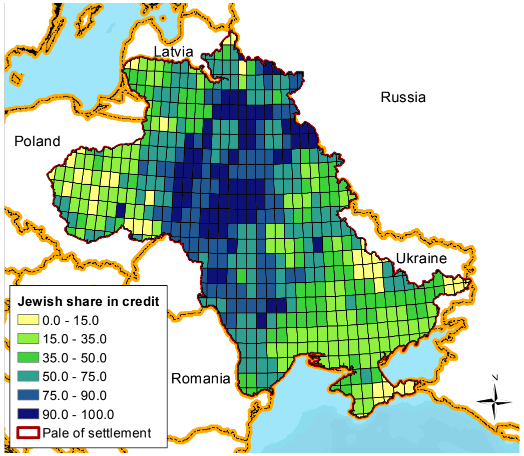
**Note:** The unit of analysis is province × year. The table presents the relationship between log of grain harvest, log of grain price, seasonal temperature shocks, macro-economic shocks, and political turmoil for provinces outside the Pale of Settlement. There are 35 provinces in the European part of the Russian Empire outside the Pale in total. Yield data are not available for the provinces in the Kingdom of Poland in all years and for all provinces in several years. Standard errors are corrected for both spatial and temporal correlations following Hsiang (2010) in a radius of 250 km and 1 temporal lag. *** p<0.01, ** p<0.05, * p<0.1

**Figure A1:** Spatial distribution of Jews and Jewish presence in different occupations in 1897

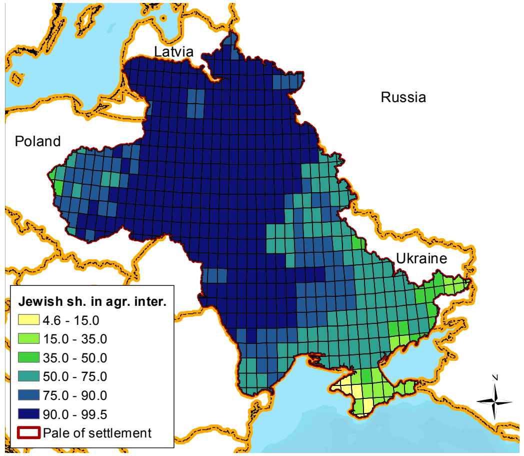
**(a)** The share of Jews



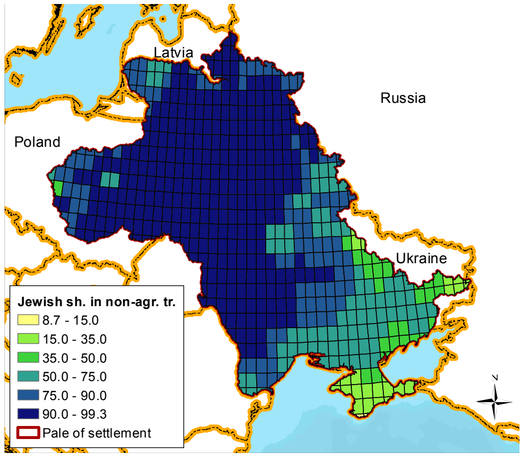

**(b)** The share of Jews among moneylenders



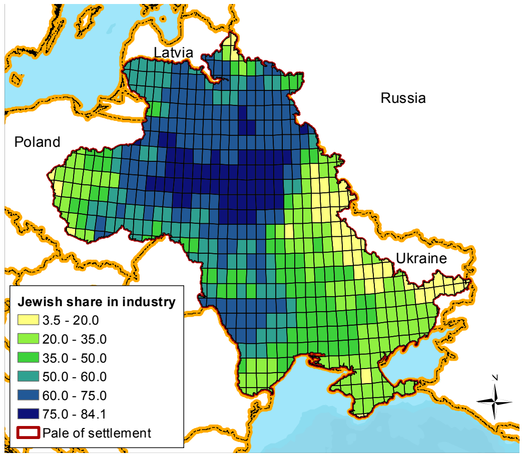

**(c)** The share of Jews among trades in agricultural goods



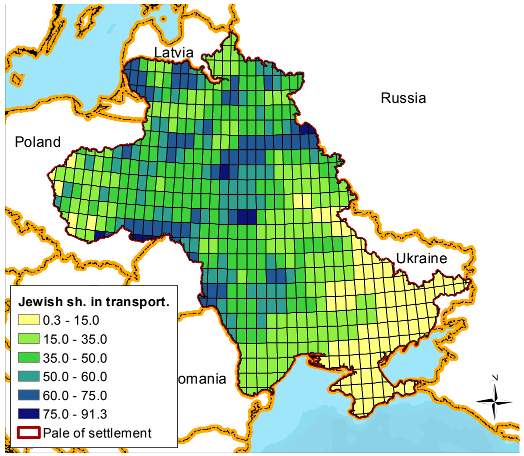

**(d)** The share of Jews among traders in non-agricultural goods




**(e)** The share of Jews among employed in crafts/industry



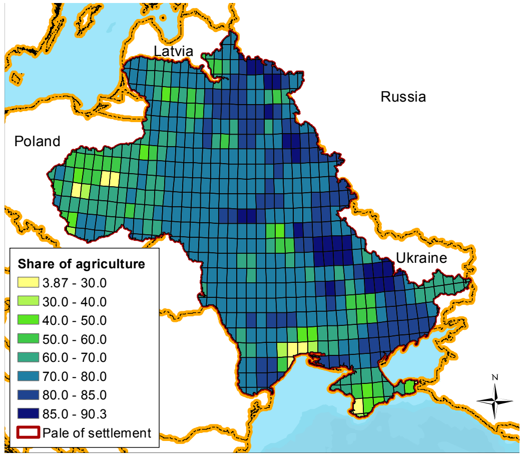

**(f)** The share of Jews in transport



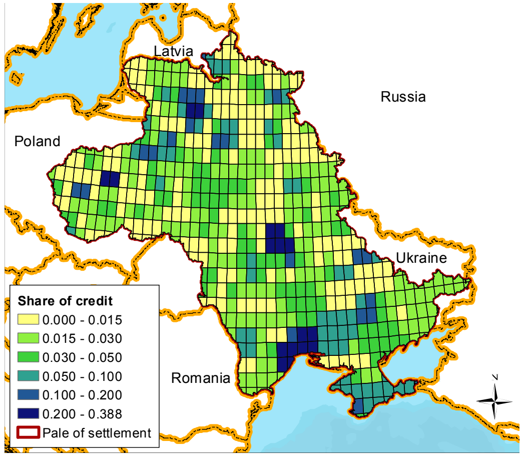

**Note:** Source: 1897 census of the Russian Empire.

**Figure A2:** Spatial distribution of the share of different occupations in total employment in 1897

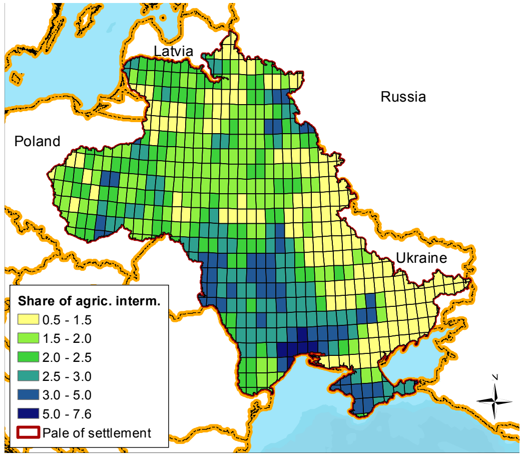
**(a)** Peasants



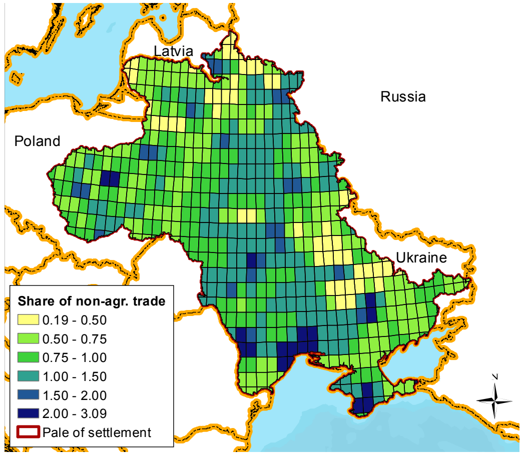

**(b)** Moneylenders



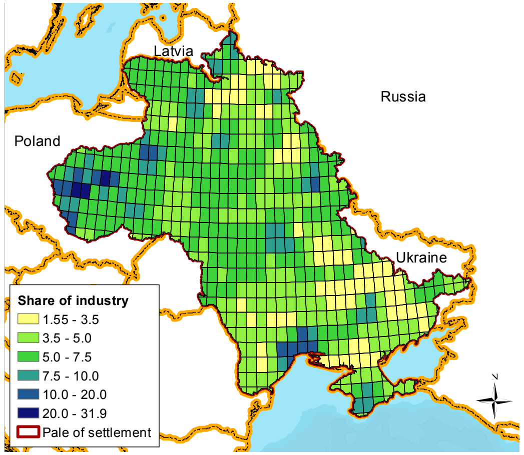

**(c)** Trades in agricultural goods



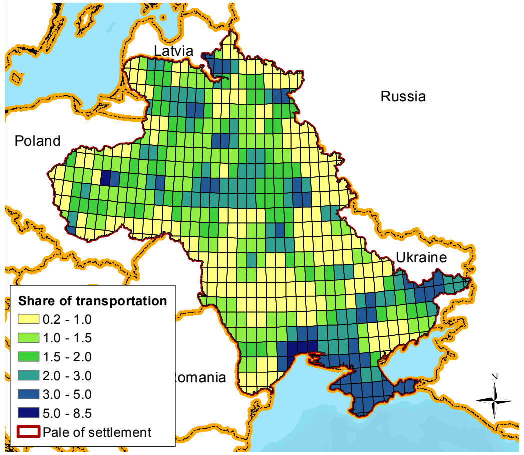

**(d)** Traders in non-agricultural goods




**(e)** Crafts/Industry



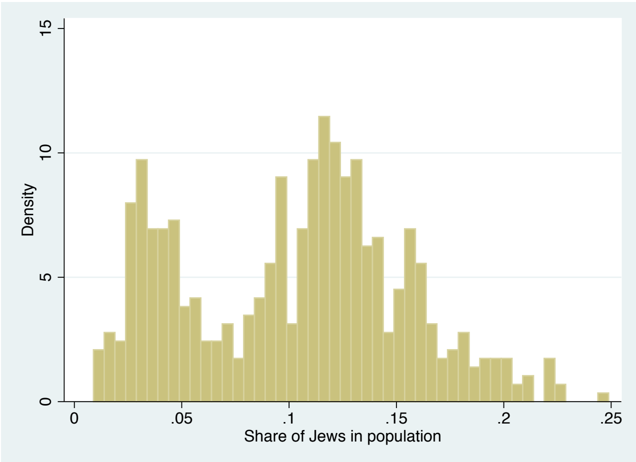

**(f)** Transport



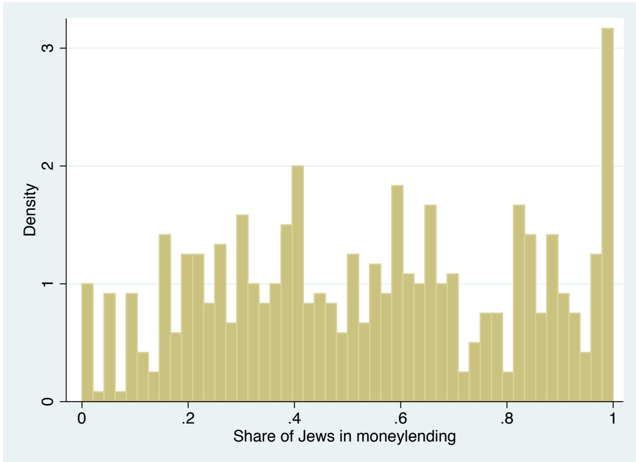

**Note:** Source: 1897 census of the Russian Empire.

**Figure A3:** Histograms of the shares of Jews in local population and in local employment in different occupations in 1897 across grid cells

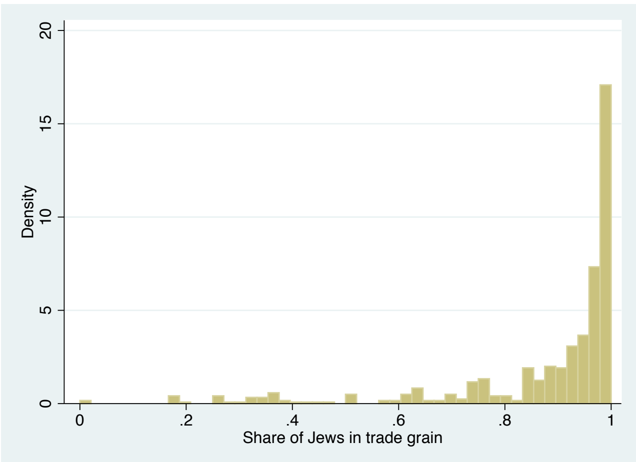
**(a)** Total



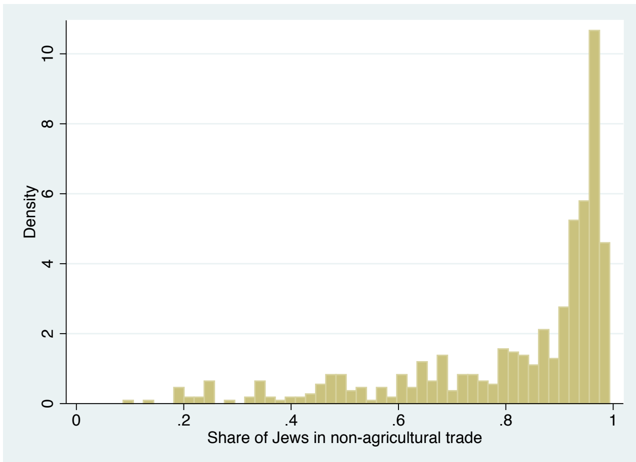

**(b)** Moneylenders



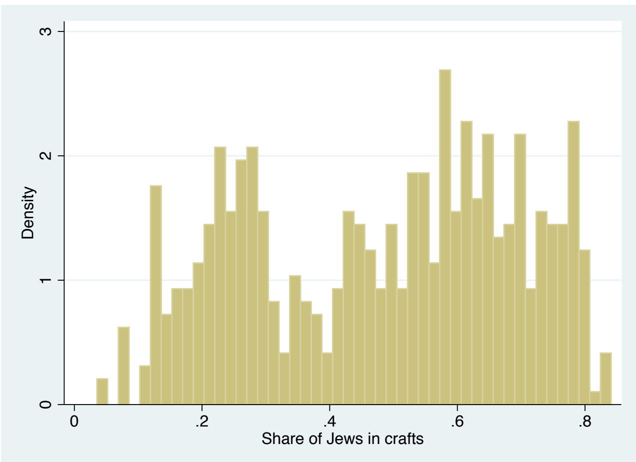

**(c)** Traders in grain



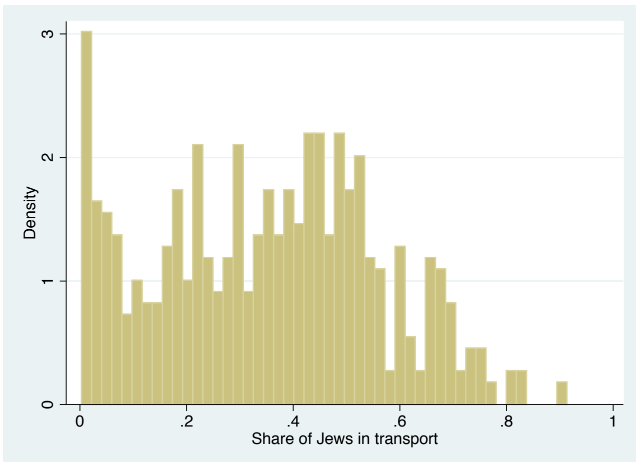

**(d)** Traders in non-agricultural goods




**(e)** Employed in crafts/industry



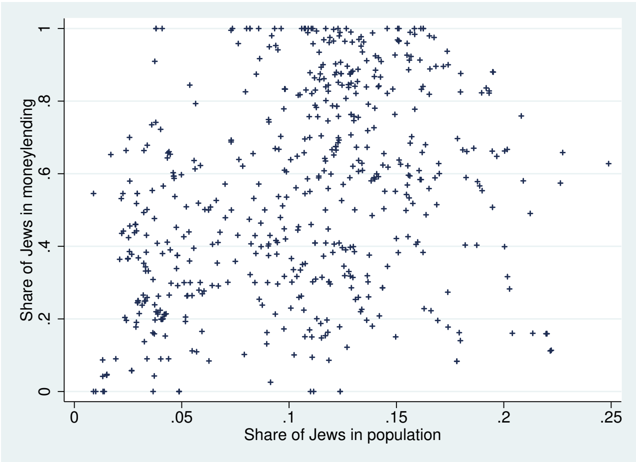

**(f)** Transport



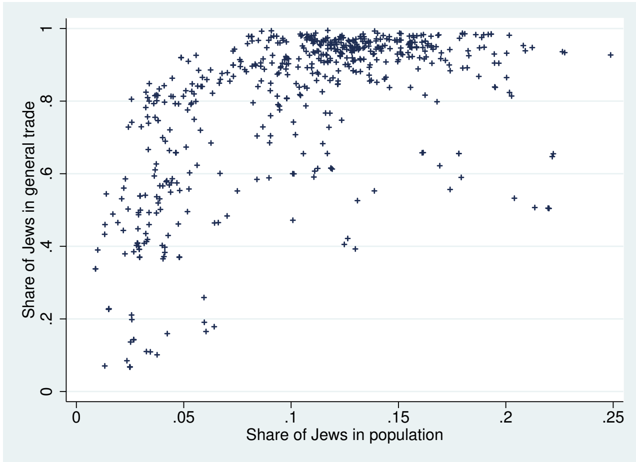

**Note:** Source: 1897 census of the Russian Empire.

**Figure A4:** Correlation between the share of Jews in the local population and the local shares of Jews among different occupations in 1897 across grid cells

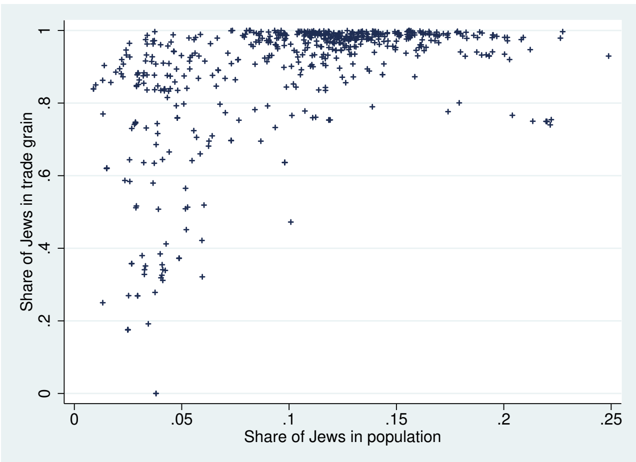
**(a)** Moneylenders



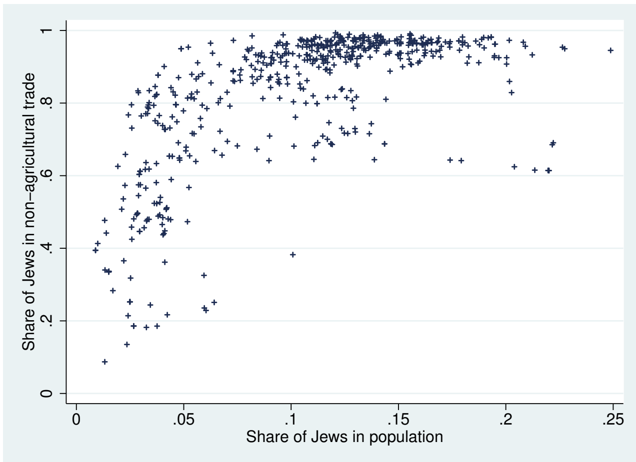

**(b)** General traders



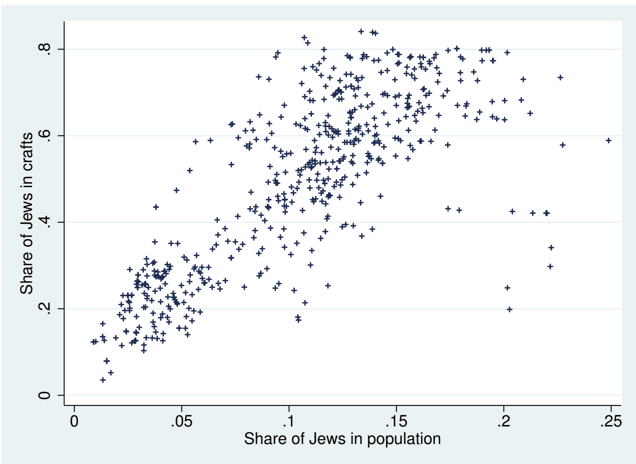

**(c)** Traders in grain



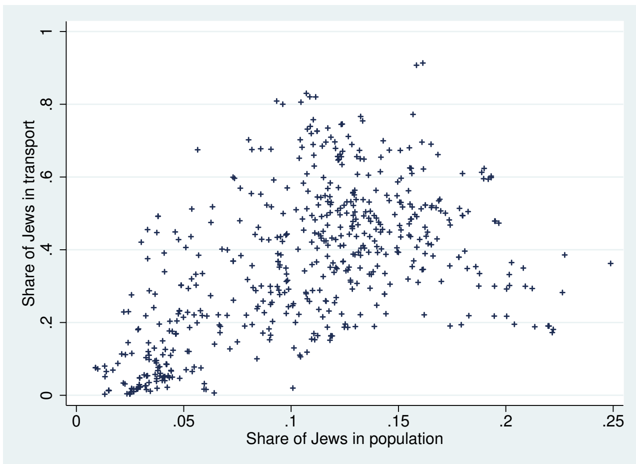

**(d)** Traders in non-agricultural goods




**(e)** Employed in crafts/industry



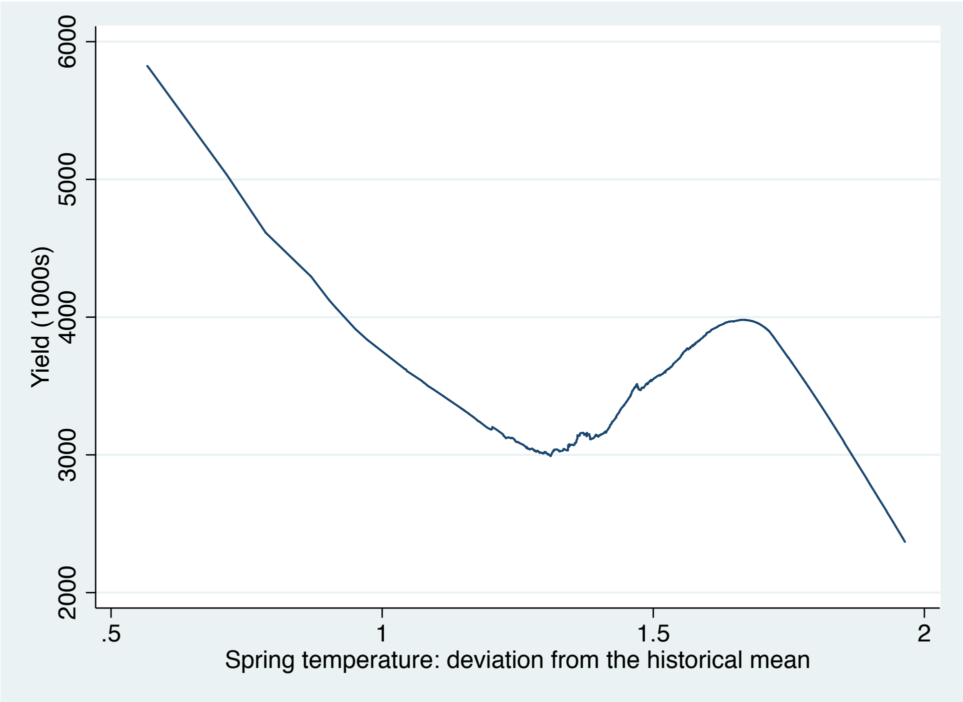

**(f)** Transport



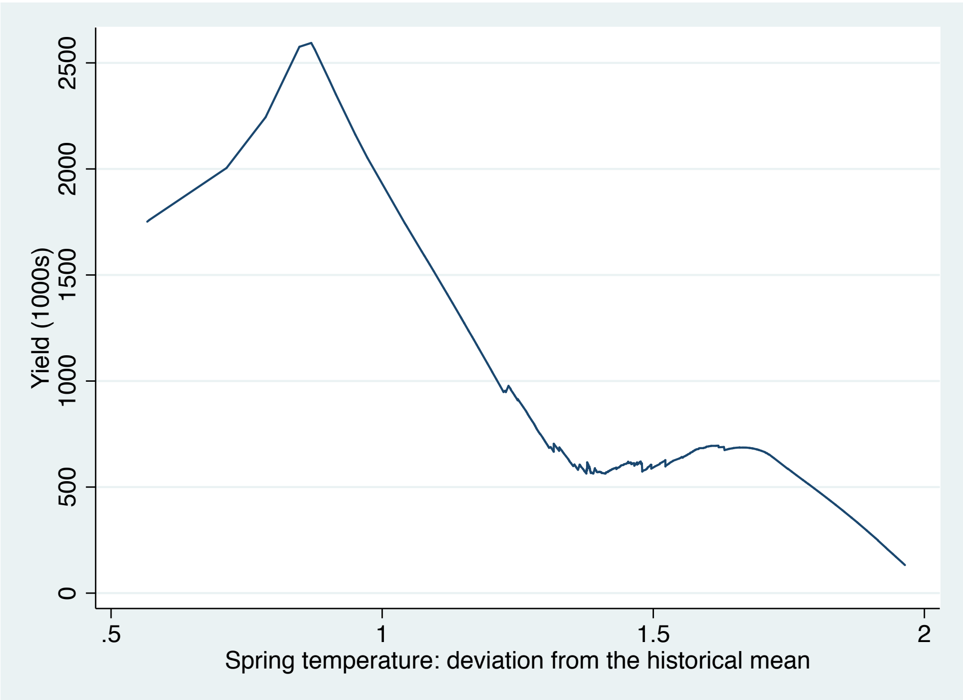

**Note:** Source: 1897 census of the Russian Empire.

**Figure A5:** Relationship between spring temperature and grain yield in 1913—1914

**(a)** Winter grains



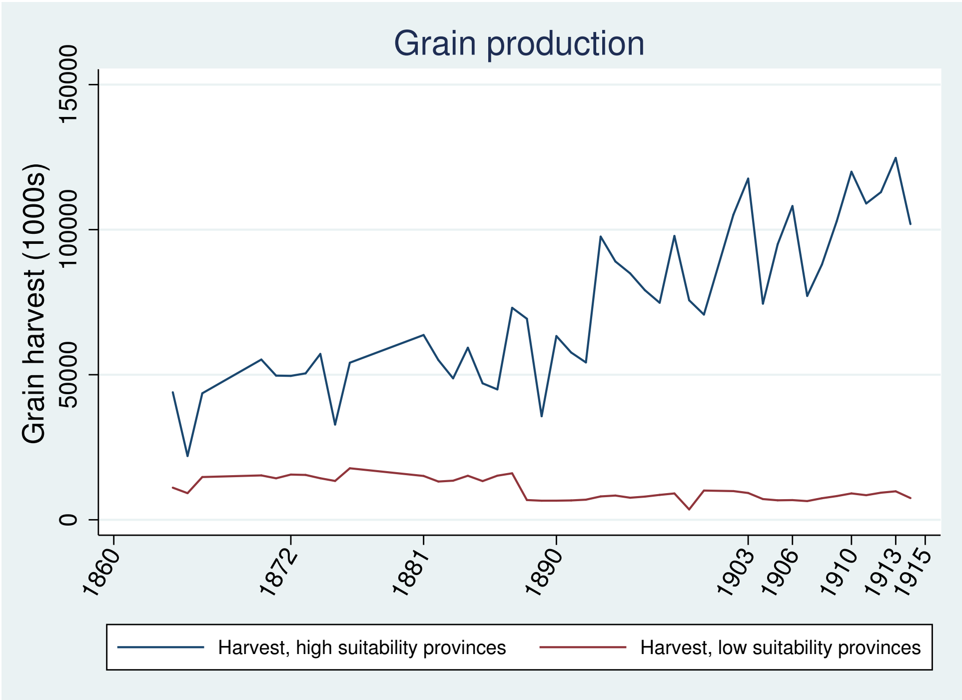

**(b)** Spring grains



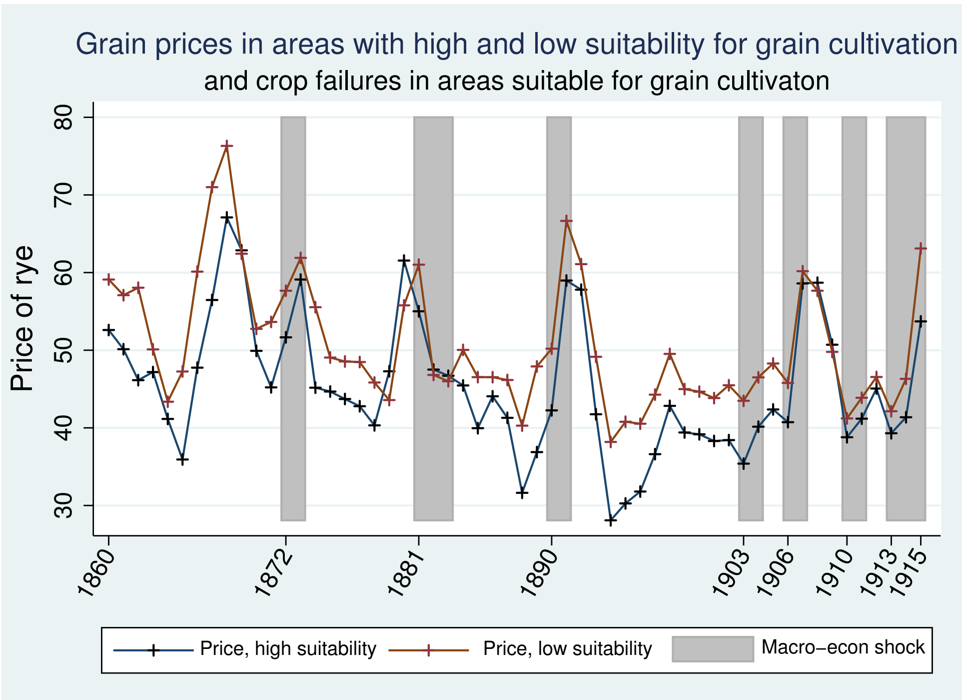

**Note:** The figure presents unconditional non-parametric locally-weighted regressions (LOWESS) between winter and spring grain yield and the deviation of spring temperature from historical mean across 236 districts in 1913 and 1914. Panel A presents the relationship for winter grains and Panel B – for spring grains. Yield is measured in 1000s of *poods*. (*Pood* is unit of mass equal to 16.38 kilograms.) Spring is defined as the second quarter.

**Figure A6:** Grain production and grain prices by grain suitability and agro-climatic shocks in areas more suitable for grain cultivation inside the Pale

**(a)** Grain harvest by suitability for grain cultivation

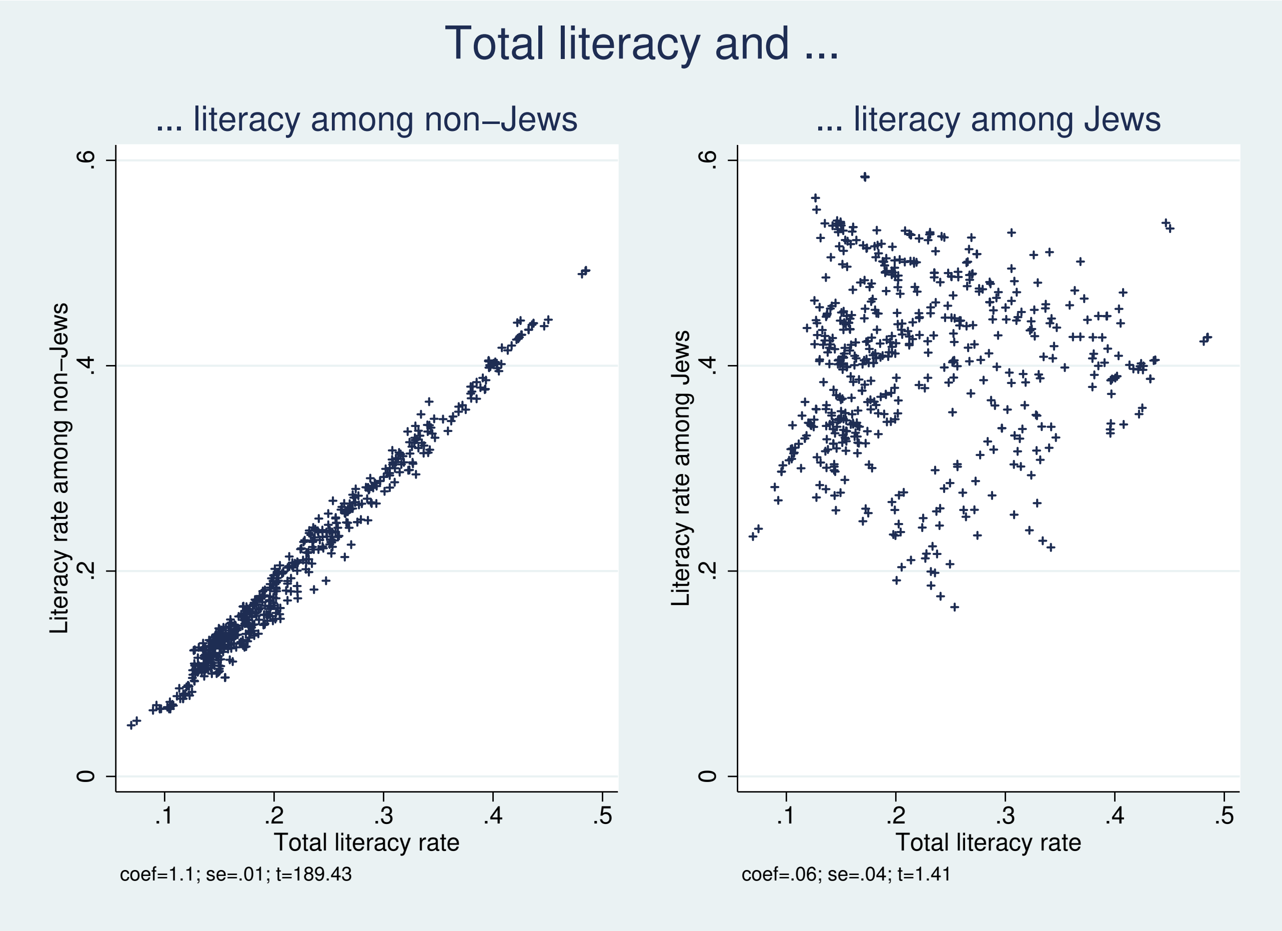



**(b)** Grain price in more and less suitable areas and agro-climatic shocks in more suitable areas for grain cultivation




**Note:** Provinces in the Pale of Settlement were divided into two groups with below and above median suitability for grain cultivation. Panel A and Panel B present the aggregate production and grain prices in these two groups of provinces. Shaded areas in Panel B show the times of a macro-economic shock, defined as agro-climatic shock that caused crop failure in at least some provinces among those more suitable for grain cultivation.

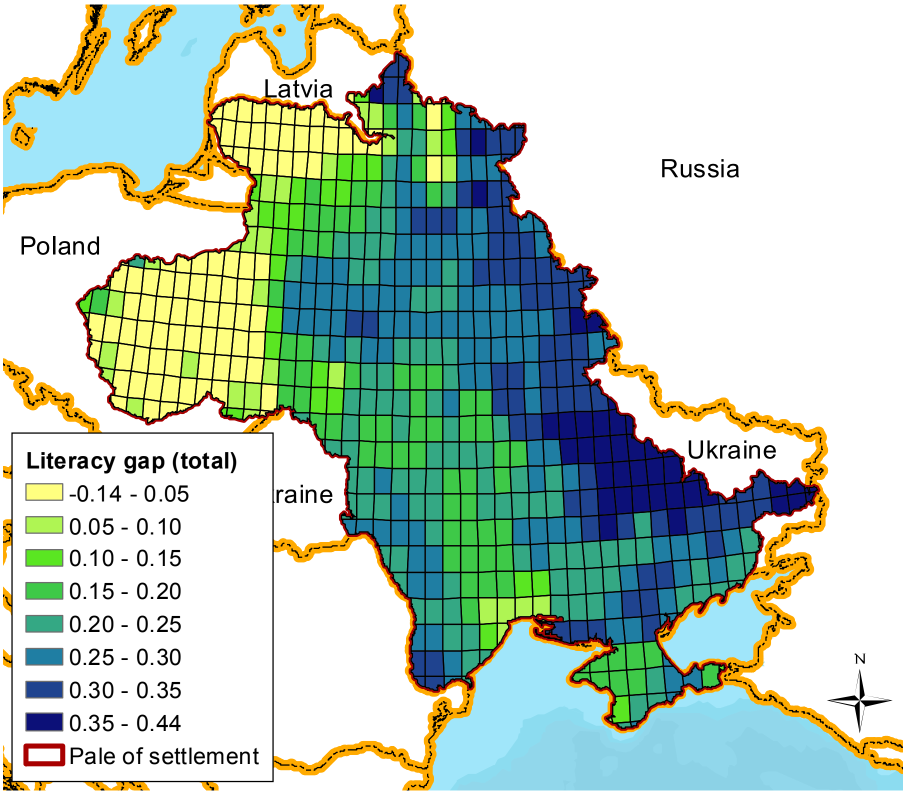
**Figure A7:** Total literacy rate is uncorrelated with the literacy of Jews



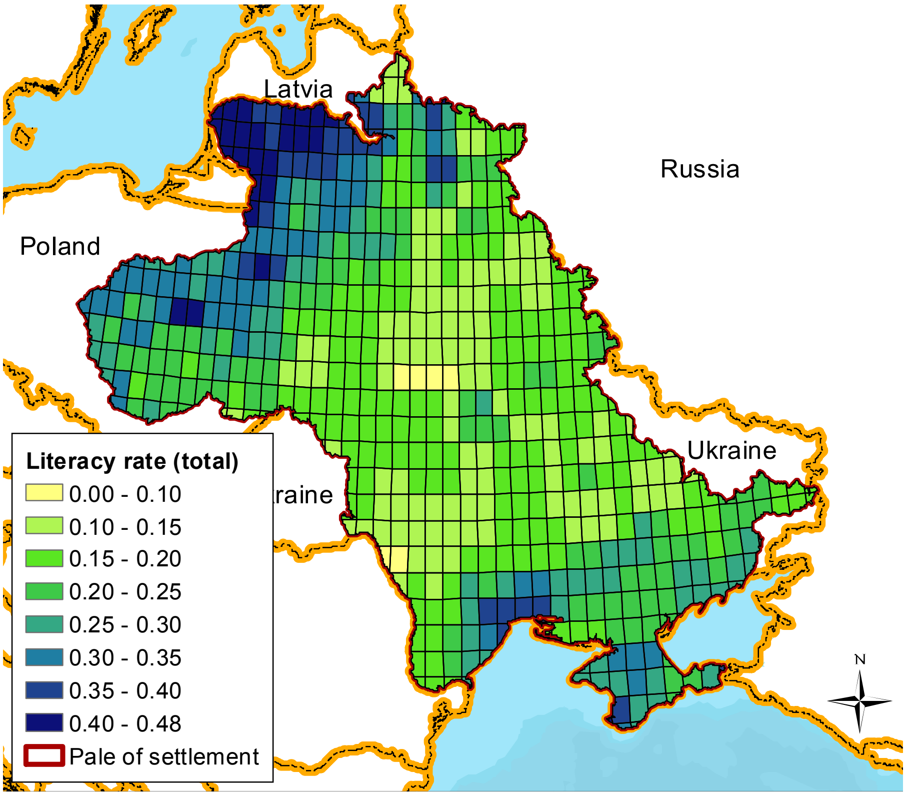

**Note:** The figure presents the unconditional scatter plots, in which the total literacy rate is related to the literacy of non-Jews (left plot) and to the literacy of Jews (right plot).

**Figure A8:** Literacy in 1897

(a) Literacy gap between Jews and non-Jews



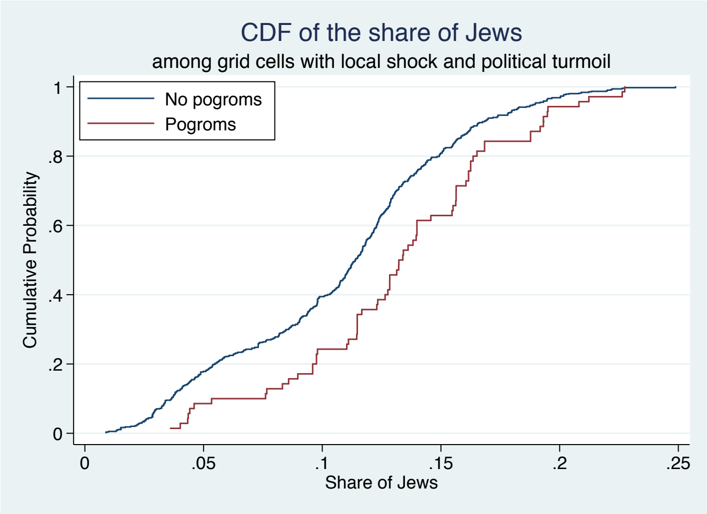

(b) Total literacy rate



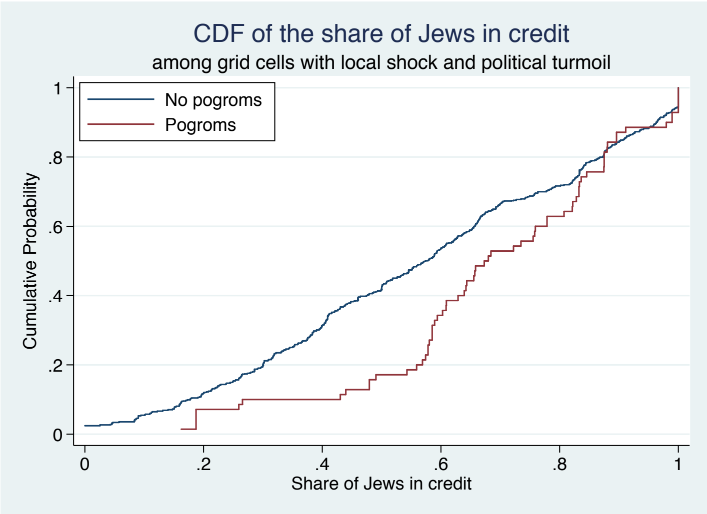

**Note:** Source: 1897 census of the Russian Empire.

**Figure A9:** Cumulative distribution functions

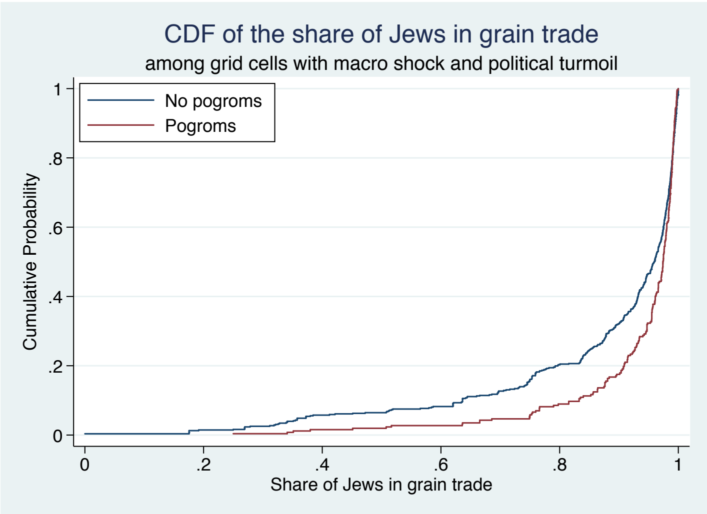
**(a)** The share of Jews




**(b)** The share of Jews among moneylenders




**(c)** The share of Jews among grain traders




**Note:** Panels A and B of the figure present the CDFs of the share of Jews among moneylenders and the share of Jews in local population among grid cells with a hot spring during political turmoil separately for grid cells with and without pogrom occurrence. Panel C presents the CDF of the share of Jews among grain traders in all grid cells which did and which did not experience pogrom during the intersection of a macro-economic shock and political turmoil.

# B Sources used to compile data on pogroms


- *American Jewish Year Book*, Vol. 8 (1906-1907).
- *Persecution of the Jews in Russia 1881. Talbot collection of British pamphlets. Reprinted from the "Times," with Map and Appendix.* (1882). London: Spottiswoode & Co., New-Street Square.
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- *Encyclopaedia Judaica* (2007). Second Edition. Volume 16, pp: 279-282.
- Klier, John D. and Shlomo Lambroza (1992). *Pogroms: Anti-Jewish Violence in Modern Russian History*, Cambridge University Press, New York.
- Miliakova, Lidia ed. (2010). *Le livre des pogroms. Antichambre d'un génocide Ukraine, Russie, Bielorussie 1917-1922*, Paris: Calmann-Lévy/Mémorial de la Shoah. (French, also Russian edition.)
- Sherman, Menahem (1995). *From My Parents' Home to My Homeland*, (Hebrew) Tel Aviv.
- Weinberg, Robert (1987). "Workers, pogroms and the 1905 revolution in Odessa." *The Russian Review*, 46(1) : 53-75).
- *Yevreyskoyeistoriko-etnograficheskoye obshchestvo, Materialy dlya istorii anti-yevreyskikh pogromov v Rossii* (Russian), 2 vols. (1919–1923).
- *Yevreyskiye pogromy 1918–1921* (Russian)—album (1926); He-Avar, 9 (1962), 3–81; 10 (1963), 5–149; 17 (1970), 3–136.
- "List of Ukrainians pogroms," The New York Times, 11 September 1919.
- "A record of pogroms in Poland," The New York Times, 1 June 1919.
- Online sources for pogrom data (accessed on My 9, 2017):
  - http://www.jewishvirtuallibrary.org/
  - http://www.yivoinstitute.org/
  - http://www.rujen.ru/
  - http://ajcarchives.org/main.php

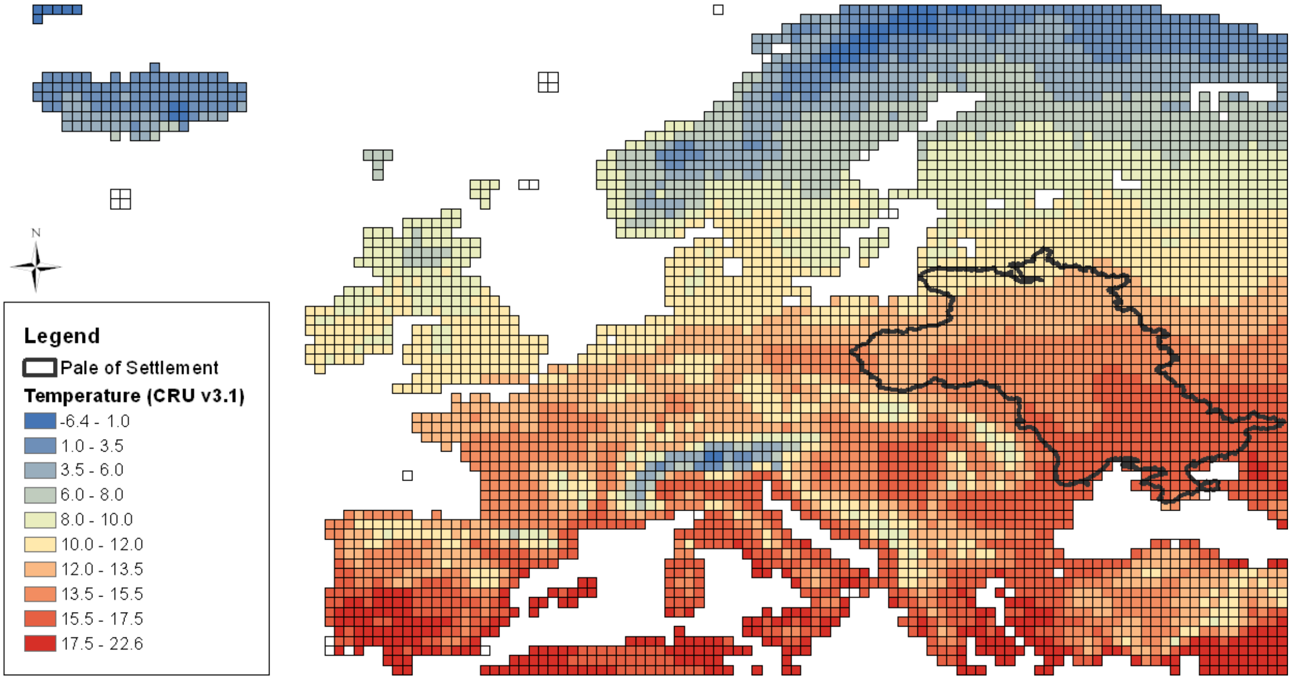
# C Correcting for the discrepancy in spring temperature in 1881 and 1882

We use historical monthly weather stations data provided by the Global Land Surface Databank (Rennie et al., 2014) to compute spring temperature in 1881 and 1882 at the grid cell level. We use the "IDW (inverse distance weighted)" tool of ArcGIS® software for this purpose. IDW is an interpolation technique that determines cell values using a linearly weighted combination of a set of sample points. The weight is a function of inverse distance of the cell and sample points. Before performing the interpolation, we compute the temperature at the sea level for each weather station. We assume that every thousand meters the temperature falls by 6.4 C degrees. After the IDW interpolation, we import the interpolated data into Stata and calculate spring temperatures at the exact altitude level (instead of sea level) for each cell.

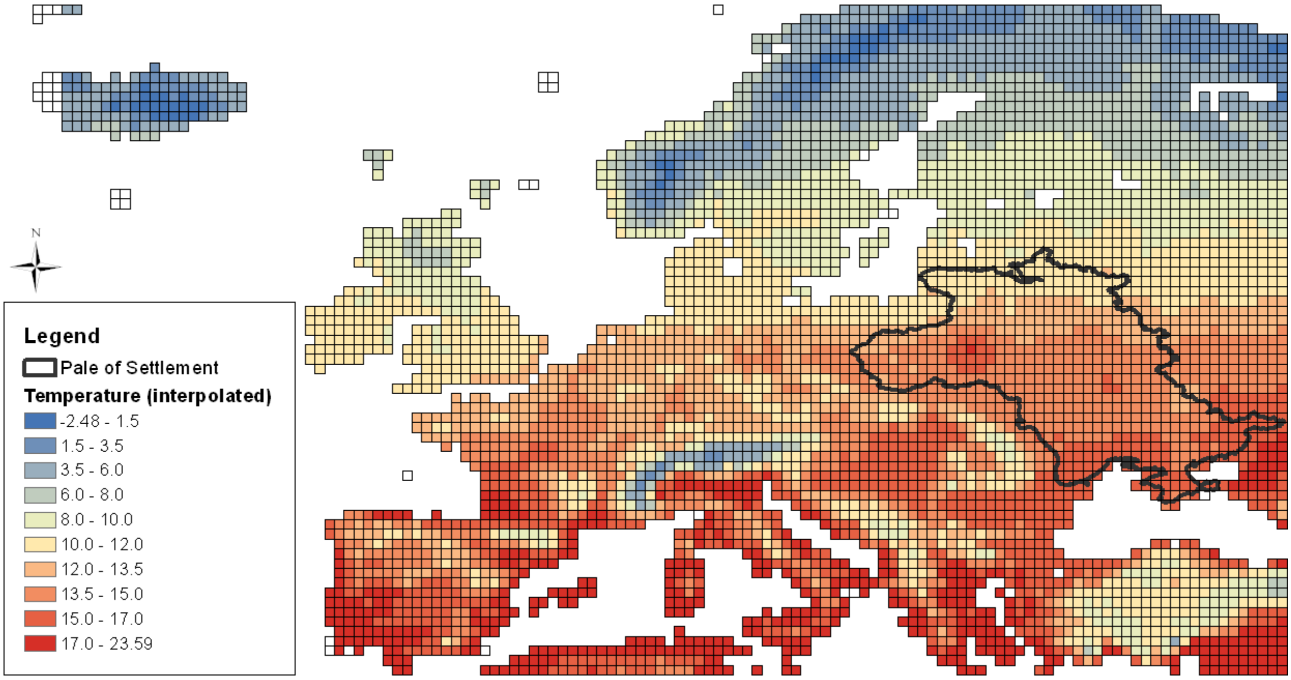
To check our interpolation quality, we perform this procedure not only for 1881 and 1882, but also for the 1900–2000 period and match it to the CRU TS v3.1 dataset. CRU TS is the most commonly employed global gridded climate data set and reconstructed historical seasonal temperature data by Luterbacher et al. (2004) and Xoplaki et al. (2005) is calibrated for the period 1901-2000 to earlier versions of CRU TS. Panel (a) and (b) of Figure C1 present the spring temperature in 1901 according to the CRU TS v3.1 data set and to our interpolation, respectively. Table C1 presents the correlation between spring temperature according to the CRU TS v3.1 data set and our interpolated spring temperature data for the period 1901—2000. Column 1 shows the correlation for the whole sample presented in Figure C1; point estimate is almost one and interpolated spring temperature can explain 94.8 per cent of the variation in the spring temperature according to CRU TS v3.1 data set. Column 2 shows the correlation for the grid cells within the Pale: point estimate is 0.87 and interpolated spring temperature can explain 87.6 per cent of the variation in the spring temperature within the Pale according to CRU TS v3.1 data set.

Figure C1: Spring temperature of 1901

(a) CRU TS v3.1 data set




(b) Interpolation from weather station observations




**Note:** This figure represents the spring temperature in 1901 in Europe. The more blue the color is, the colder the temperature is; the more red the color is, the warmer the temperature is. The Black line represents the Pale of Settlement area in which Jews were allowed to reside in the Russian Empire.

**Table C1:** Interpolation quality check: spring temperature correlation, Conley = 100km & 1st temporal lag

| Temperature in spring (CRU TS v3.1) | (1) All cells | (2) The Pale |
|---|---|---|
| Temperature in spring (interpolated) | 0.9834*** | 0.8784*** |
| | (0.0004) | (0.0018) |
| Observations | 486,060 | 57,500 |
| R-squared | 0.948 | 0.876 |

**Note:** Standard errors are corrected for spatial and overtime correlation.
*** p<0.01, ** p<0.05, * p<0.1