Middleman Minorities and Ethnic Violence: Anti-Jewish Pogroms in Eastern Europe*

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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 a sharp increase in uncertainty about the future. Crop failures without political turmoil did not cause pogroms. During political turmoil, local crop failure turned insolvent peasants against the Jews, in localities where Jews dominated moneylending. Pogroms also broke out in places where Jews dominated trade in grain when political turmoil coincided with crop failures in at least some areas, presumably causing an increase in grain prices. When political situation was stable, negative economic shocks did not instigate pogroms because the majority valued future services of Jewish middlemen. In contrast, at times of political turmoil, middlemen became the primary target of mob violence following economic shocks as the majority remained depended on the current services of middleman minority but the future value of these services fell due to increased uncertainty about the future.

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Keywords: Middleman minorities; Pogroms; Jews; Climate shocks; Ethno-occupational segregation, Conflict, Political uncertainty

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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, 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. Many of the same examples apply (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) makes 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 Protestant majority leading to their expansion into moneylending, traditionally dominated by Jews. However, many episodes of violence targeted at middleman minorities occurred without any major cultural revolutions.

In this paper, we examine the determinants of the outbreaks of anti-Jewish 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, 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 0.5×0.5 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 correlation.

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), which, at times, but not always, were coupled with the weakness of the state. 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 extreme political uncertainty 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). Figure 2 shows that pogrom waves occurred every time when crop failures in some areas within the Pale

of Settlement coincided with the periods of a sharp increase in political uncertainty. Several episodes of extremely bad harvest took place before the first wave of pogroms or in between pogrom waves. These agro-climatic shocks *per se*, i.e., without political turmoil, did not inflict ethnic violence. Our estimates imply that 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) at times of increased political uncertainty and had a zero effect on the likelihood of pogroms in times of a relative political peace. 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. This finding contrasts with the traditional "scapegoat" theory, according to which Jews were blamed for all economic misfortunes. 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 time of extreme uncertainty about the future, 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 following a sharp rise in discount rates due to an increase in uncertainty, which during the last wave of pogroms was exacerbated by the collapse of the state.[1] When majority did not see the future, economic shocks resulted in violence against the Jews.

Figure 3 illustrates the second key determinant of pogroms, i.e., whether Jews dominated 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 a negative agro-climatic shock at times of political turmoil is 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. Furthermore, to establish causality we rely on the argument presented by Botticini and Eckstein (2012) about the advantage of Jews in moneylending because of 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 severe local agro-climatic shock coupled with a political

[1] 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.

turmoil the probability of a pogrom in a grid cell, where the share of Jews in the credit sector is one SD above the mean, is 7.4% percent; and in a grid cell, where the share of Jews in the credit sector is one SD below the mean, it is 0.7% percent. (The mean value of the share of Jews among creditors is 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 is 0.5%.)

Panel B of the figure shows that at the intersection of political turmoil with crop failures in this or previous year at least in some areas of the Pale, the frequency of pogrom occurrence is substantially higher in localities where the share of Jews among traders in grain is above 85%, which is the case in three quarter of all grid cells, than in localities where the share of Jews among traders in grain is below 85% (one forth of grid cells). In the empirical analysis, we show that this correlation is also robust to including covariates for potential confounds and adjusting standard errors for spatial correlation. Importantly, the pogroms in localities where Jews dominate trade in grade took place irrespective of whether crop failure was local, or it affected other localities. This was the case presumably because crop failures in some Pale localities affected the price of grain in other Pale localities. The magnitude of the estimated effect is as follows: Our estimates imply that during global agro-climatic shock coupled with a political turmoil the probability of a pogrom in a grid cell, where the share of Jews among traders in grain is one SD above the mean, is 7.4% percent; and in a grid cell, where the share of Jews in the credit sector is one SD below the mean, it is 4.9% percent. (The mean value of the share of Jews among traders in grain is 87.9% with standard deviation of 18.4 percentage points.)

This evidence suggests that in times when economic and political crises coincide, 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 uncertainly about the future.[2] 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, the evidence suggests that middleman occupations including specialization in moneylending and grain trade were an optimal choice for Jews *ex ante* as neither the Jews, nor the majority could have anticipated the unprecedented level of political instability which realized in Russia at the the end of the nineteenth century and the beginning of the twentieth century and which lead to a breakdown of the peaceful and

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

beneficial coexistence between non-Jewish majority and Jewish middleman minority.

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 were brought about by political turmoil of the 1848 revolution 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 as follows: *"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 at the intersection of economic and political crises (Boyer and Nissenbaum, 1974).

We contribute 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) and Esteban, Morelli and Rohner (2015). Our study contributes to this literature in two ways. 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 stop 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 or conversely stress the adverse effect of competition on the goods or labor market between ethnic groups as a determinant of conflict; on the other hand, sociological literature (e.g., Bonacich, 1973; Chua, 2004; Sowell, 2005) and historical literature (e.g., Slezkine, 2004) document the episodes of violence against ethnic minorities segregated along the occupational lines. Our paper is closely related to Becker and Pascali (2016) who document another mechanism through which Jewish moneylenders

became the primary target of ethnic violence in Western Europe despite previously having provided services to the majority. They show that a shift in attitudes of the Protestant majority toward usury during the Reformation broke the equilibrium of peaceful coexistence between Jewish middleman minority and the majority.

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) 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 social consequences of prosecution of Jews (e.g., Acemoglu, Hassan and Robinson, 2011; Akbulut-Yuksel and Yuksel, 2015; D'Acunto, Prokopczuk and Weber, 2015; Spitzer, 2015).[3]

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. In Section 4 we formulate the empirical question and describe the data. Section 5 discusses the estimation strategy. Section 6 presents the results. And Section 7 presents the conclusions.

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 finalised 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 merchant, which prohibited them from getting involved in agriculture and owning arable land.[4] These restrictions lasted

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

[4] 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.

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 trader 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 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, and artisans across grid cells in the Pale.[5] 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 mob violence, i.e., pogroms. Pogrom is a violent mob attack directed specifically at the Jews as ethnic and religious group, which involved physical assaults on Jews (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). The informa-

[5] 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.

tion about historical pogroms was put together by several Jewish historians primarily from archival records of police reports and testemonies. 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 intersection of 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 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 failures (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 the 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 Ruso-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 or an absent 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, 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, which occurred in 1881, however, politically was 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 substantial reduction in civil liberties and to an abandonment of the Alexander's liberalisation reforms, that eventually should have led to the first constitution.

Both the uncertainty about the future and 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 and by Snyder (2016) about the Holocaust). As we described in the previous section and 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 state capacity to enforce order. The weakness of the state must have facilitated pogroms. Yet, since the first pogrom wave was not at all associated with a weak state and the second may have but only partially, it is evident that the weakness of the state was not the main driver of pogroms.

3 Research question

We investigate the conditions under which pogroms broke out in the Russian Empire. In particular, we examine how the economic specialisation 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 panel data set at 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 Tables 1 in the main text and 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 of 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 cases of violence against Jews known to be perpetrated solely by the police and the military without participation of local population.

The resulting data set includes information on the locality in which each pogrom took place and the date (with few dates missing). We geo-referenced the locations of all pogroms and built a panel data set at a grid cell level with 0.5×0.5 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 vast majority of our sample.

We construct two measures of violence against the Jews: 1) a dummy variable that takes the value of 1 if a pogrom took place in a given year and grid cell, and 0 otherwise;

2) the number of pogroms that took place in a given year and grid cell. 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 summarises the data on pogroms across grid cell × 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 digitise 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).[6]

1897 census also provides information on literacy levels in Russian language and in the native language separately by native language. We use data on the overall literacy rate of local population, and the literacy rate of people with Jewish native languages (i.e., Yiddish and Modern Hebrew), and literacy rate of people with native languages other than Jewish. In the Pale of Settlement, the total literacy rate was 22%, the literacy rate among the Jews was 37%, and literacy rate among non-Jews was 20%.

[6] The list of the occupations is very detailed. We aggregated some 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, 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, other production. We define transport as a sum of water transport, rails transport, horses transport, and other means of transport on land.

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 share of Jews in local population and in employment of various occupations and the correlation between the prevalence of Jews in the local population and in different occupations.

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.

Yield data: 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, 2017).[7] 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.

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 Durante (2010). 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) reconstruct historical temperature by calibrating the indirect proxies to gridded data based on weather station observations by Mitchell and Jones (2005) for the twentieth century and extending time-series backwards 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. However, the historical accounts do document exceptionally

[7] Data on grain yield on a province level are not available for the Polish provinces of the Russian empire, called the Kingdom of Poland.

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 contradicts 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, for all other years, we use the latter.[8] The reconstructed historical climate data provides 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. 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. We then normalize this difference by the standard deviation of the season temperature in that 75-year period to account for variability of climate. Second, we construct dummies for the extremely hot and extremely cold season temperature 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.

4.2 Agro-climatic shocks: seasonal 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;

[8] In the online appendix, we provide details of the discrepancy between the two data sets and describe the interpolation procedure.

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 to only to 82% by 1913; agriculture contributed the most to 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 importance of agriculture to the economy and to the use of backward technologies, climate shocks had a large effect on grain yield, which, in turn, 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. 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%.

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 clusters at the province level. 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 included together as regressors. 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. 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 spiring 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 fixe effects). The figure also illustrates the strong relationship between extremely hot spring and crop failure as well as no relationship between other seasonal temperature shocks and yields.[9]

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.[10] One standard deviation increase in the spring temperature, on average, lowers the province's grain yield by 1,077 thousand *tchetverds*.[11]

[9] Table A4 in the online appendix establishes robustness of the relationship between spring temperature shocks and yields to using logs rather than levels.

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

[11] 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 (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 has increased

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 affect 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 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 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 for the main output of the agricultural production in the Pale of Settlement. Therefore, in the empirical analysis below we focus on the hot spring as a measure of negative agro-climatic income shock. Throughout the rest of the paper, we use two alternative measures of a spring temperature shock: (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 the distribution.

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 time-specific shocks 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 shock—is a measure of agro-climatic negative shocks. We consider two types of economic shocks: local shocks and macro shocks. Local economic shocks are measured in two ways: it is either a dummy for the extremely hot spring indicating that the

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 LIA.

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 define a macro-economic shock as a dummy that equal one when at least some grid cells 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 of the same year and before the planting season of the following year. The macro shock variable varies only over time, thus, in the specification that uses this variable, E_{it} is substituted 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. μ_t is the year fixed effect, and η_i is the grid-cell fixed effect. To separate the effect of the presence of Jews from their specialisation in middleman occupations, we include interactions of the shares of Jews in the local population with both types of 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 economic and political shocks with the size of the relevant occupation, e.g., when we consider specialisation of Jews in moneylending, we control for the share of money lenders in total employment and for a dummy indicating the absence of the credit sector in the locality interacted with both political and economic shocks.[12] As both ethnic violence and climate shocks are spatially correlated and correlated over time, we correct standard errors for both spatial and temporal correlation 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. In the robustness section, we establish robustness of the results to various alternative assumptions about the variance-covariance matrix. To facilitate the interpretation of estimated coefficients in regressions with the continuous measure of local economic shock (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 $E_{it}P_t(M_i - \bar{M})$.[13]

[12] In order to keep the same sample across specifications, we define the share of Jews among moneylenders to be equal to one when there are no moneylenders in the locality. Employment in all other conciderd occupations is above zero in all localities.

[13] Note that the continuous measure of local economic shock E_{it} is standardised by definition and, thus, also has a zero mean.

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 a unobserved reason. Such endogenous location decisions could create a spurious negative correlation 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 first pogrom wave certainly had an effect on the presence of Jews and the ethno-occupational structure of the localities in the Pale of Settlement, as it in some areas led to a significant number of deaths and also triggered substantial outmigration of Jews to the US and large cities, where it was easier to hide.[14] 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 the specialisation of Jews in middleman occupations interacted with economic and political shocks and pogroms conditional on the local share of Jews that we document in the next section.

We correct for these and other potential sources of endogeneity for specialisation 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. 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 as well as 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 A6 in the online appendix shows that total literacy rate is uncorrelated with the literacy of Jews and is strongly correlated with

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

literacy of non-Jews. Figure A7 in the online appendix presents the maps of spatial distributions of literacy rate among Jews and of the total literacy rate. 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. In order to make the first stage more precise, we also include a dummy for the three historic capitals, Kiev, Warsaw and Wilno, interacted with economic and political shocks to a set of covariates in the baseline IV specification because the literacy rate of non-Jews is substantially and significantly higher in these three cities compared to other locations in the Pale of Settlement. In order to calculate standard errors corrected for spatial and temporal correlation with IV and 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 that may require literacy interacted with agro-climatic and political-turmoil shocks. As a robustness check, we also control for urbanization level interacted with economic and political shocks, as 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 specialisation 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 the 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 gap.

6 Results

6.1 Pogroms and local economic and global political shocks

First, we test for the relationship between pogroms and economic and political shocks. As a starting point, we verify that the local negative economic shocks, on average, increased the probability of ethnic violence against Jews in the Pale of Settlement. Panel A of Figure 6 presents the unconditional non-parametric relationship between the occurrence of pogroms and the deviation of spring temperature in a grid cell and year from the historical mean for the whole sample from 1800 to 1827. The figure

illustrates a sharp increase the likelihood of pogrom occurrence in the grid cells and years that experienced extremely hot spring. Column 1 of Table 3 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 lead to ethnic violence. Column 2 of Table 3 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 at both proxies for local economics 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 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 time of political turmoil increased the probability of a pogrom in a grid cell by 3.8 percentage points or 54% of the standard deviation of pogrom occurrence. According to the estimation using the continuous measure of economic shocks (Panel B), a one standard deviation increase in the spring temperature led to a 2 percentage point increase in the probability of a pogrom. (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) 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 specialisation in moneylending

In this section, we explore how Jewish specialisation in moneylending affected the probability of violence against Jews in the midst of economic and political shocks. Table 4 presents the OLS results. As above, the two panels of the table present results for alternative measures of the local economic shocks. For the sake of the ease of comparison, column 1 restates the results presented in column 2 of Table 3. In column 3, we show that pogroms during local economic and global political 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 and global political shocks is positive and statistically significant. 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. 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 the share of Jews among moneylenders interacted with both political and economic shocks are positive and statistically significant. The coefficients on the share of Jews interacted with the economic and political shocks is also positive but not precisely estimated.[15] To illustrate these effects, Figure A8 in the online

[15]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,

appendix presents the cumulative distribution functions of the share of Jews in local population (Panel A) and of the share of Jews among local moneylenders (Panel B) separately for the grid cells with and without pogroms among grid cells which experienced agro-climatic shock during political turmoil. The figure shows that both of these distributions are substantially skewed to the right for localities that experienced pogroms.

The magnitude of these effects (according to estimates in Panel A) 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 numbers of Jews among moneylenders, it is absolutely clear that far from all of pogrom victims were directly related to Jewish creditors. However, the estimates do suggest that the origin of pogroms at the intersection of local economic and global political shocks was related to the presence of Jewish moneylenders. To illustrate this, consider an average district with 219 669 people, 22 656 Jews, 81 creditors, 44 Jews-creditors and several alternative scenarios. If ten Jews entered the district, 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 because of a measurement error, omitted variables, and reverse causality. We address this issue in Table 5 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

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.

moneylenders with local economic and global political shocks 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 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, 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 shocks at times of global 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 and as the literacy gap between Jews and non-Jews may increase the specialisation of Jews in other occupations that require literacy in addition to the specialisation of Jews in moneylending. In order to make sure that these results are not driven by such a correlation, we verify that the results are robust to including in the list of covariates the interactions of local economic and global political shocks with the shares of Jews in other main Jewish occupations. Table 6 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 and global political shocks 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, the shares of Jews 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. Because of 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 how specialisation of Jews in these other occupations affects pogroms.

In Table A5 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 correlation. Our results are robust: the coefficient on the triple interaction term between the share of Jews among moneylenders, local economic and global political shocks 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 global political turmoil.

6.3 Pogroms and Jewish specialisation in other middleman and non-middleman occupations

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 and global political shocks 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 specialisation of the minority in these other occupations.[16] Table 7 presents the results. Columns 1 to 4 include interactions with the share of Jews in these other occupations one by one and column 5 includes full sets of interactions with all five occupations (including the share of 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 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 in magnitude and marginally significant coefficient on the interaction of hot spring with the share of Jews among non-agricultural traders, but it is unrobust to controlling for specialisation of Jews in other occupations and to using

[16]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.

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 middlemen 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 irrespective of specification and, in particular, whether we control or not for the shares of Jews in all other occupations interacted with political and economic shocks. 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 results is also robust across specifications. From Figure 2, however, 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. We address this heterogeneity below.

6.3.1 Jewish specialisation in trade grain and macro-level crop failure

The Pale of Settlement was a large area, yet, it was small enough to be a single market for grain. Severe crop failures in some areas of the Pale during our observation period could have affected prices for grain everywhere inside the Pale. In addition to price for grain after the harvesting season, crop failures could also affect grain prices during the planting season of the following year. Thus, we define a dummy for a macro-economic shock to be equal to one in each year such that at least some areas in the Pale of Settlement experienced agro-climatic shock of a magnitude sufficient to cause crop failure and in each year that follows this agro-climatic shock.[17] More precisely, macro-economic shock is defined as a dummy which varies only over time and indicates that at least some grid cells inside the Pale of Settlement were affected by hot spring in the currect 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 specialization of Jews in credit, we always control for the interactions of economic 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 marco-economic shocks. The coefficient on the triple interaction between the share of Jews among grain traders, the macro-

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

economic shock, and political turmoil is positive, significant, and larger in magnitude than in the previous table. At the same time, the coefficient on the corresponding triple interaction term between the share of Jews among moneylenders with macro-economic shock and political turmoil is much smaller in magnitude compared to when we use the local economic shock (see section 6.2), and in many specifications it is no longer statistically significant. These results highlight the fact that Jewish specialisation in moneylending mattered for pogroms during political turmoil only in those localities that were directly affected by crop failures, whereas Jewish specialisation 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 global 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. Jewish traders of grain were targeted during the conjunction of political turmoil and a macro-economic shock 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.

Specialisation of Jews in other occupations was not important for driving pogroms during the intersection of economic and political shocks.[18]

In Panel B of Table 8 we combine P_t and E_t in a single dummy indicating periods when political turmoil coincided with macro-economic shocks. We do 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. We find similar results for the specialisation of Jews in trade in grain, but more precisely estimated. To illustrate these results, Panel C of Figure A8 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 at the first two quartiles of the distribution (as can be seen from Panel B of in Figure 3.

The magnitude of this effect is as follows: a one standard deviation increase in the

[18]The share of Jews in crafts and industry interacted with political turmoil has a negative and significant effect. This may be explained by the fact that crafts and industry was one of the most popular and the least well-defined occupations among Jews. It correlates most with the share of Jews (as can be seen on Figure A4). The inclusion into the set of covariates the share of Jews in the local population together with the share of Jews in industry and crafts may have resulted in multicollinearity.

share of Jews among grain traders (which is equal to 18 percentage points) increases the probability of pogrom occurrence by 1.2 percentage point 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 there we have no instrument for the share of Jews among grain traders and the OLS estimates are likely to have an attenuation bias as we discussed in section 5.2.

Finally, in Table A6 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.

7 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. Specialisation 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. 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. 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. At the end of the 19th and the beginning of the 20th century, the level of political instability in Eastern Europe was unprecedented. It could not have been foreseen by the Jews, the majority or the tsarist family, suggesting that middleman occupations were a priori an optimal choice for the society to reduce the risk of inter-group conflict.

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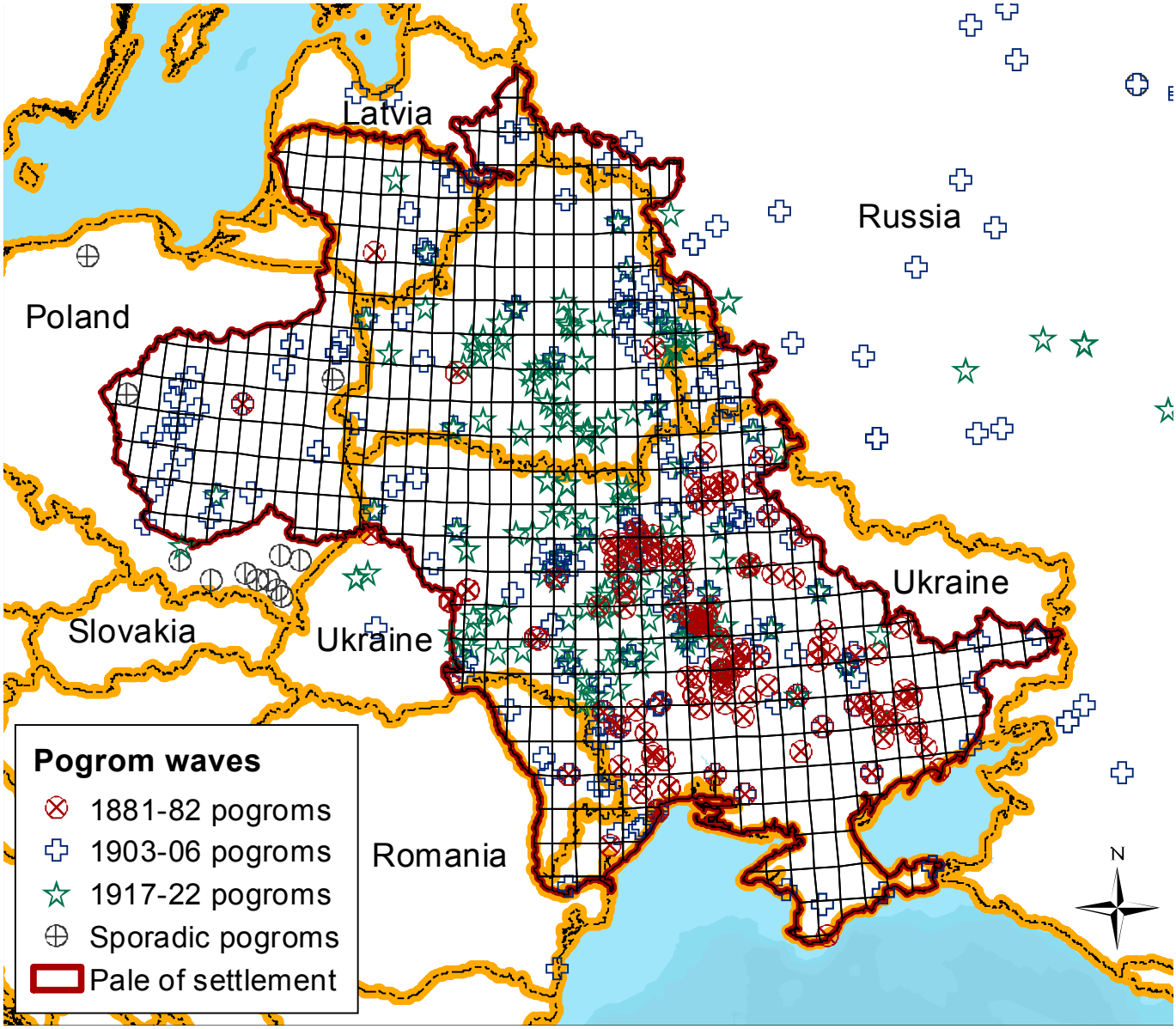
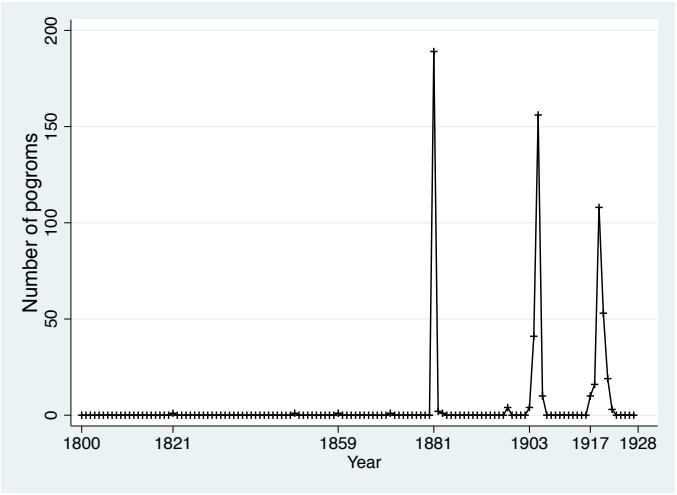
Figure 1: The Pale of Settlement and the geographic distribution of pogroms by wave



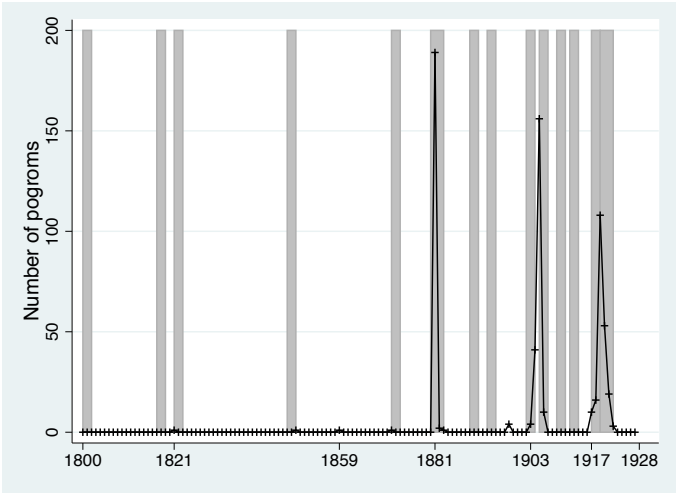
Note: The map presents the geographic distribution of pogroms in Eastern Europe in each of the three pogrom waves. The red line represents the borders of the Pale of Jewish Settlement. Orange lines represent modern country borders. The grid represents the geographical unit of analysis; each gris cell 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

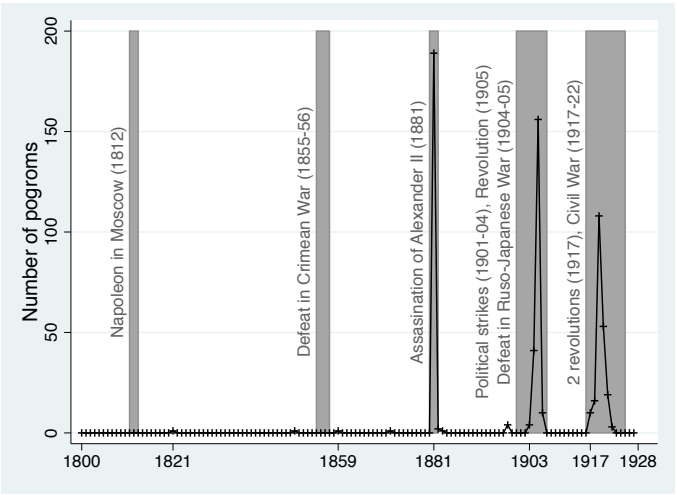
(a) Pogrom occurrence



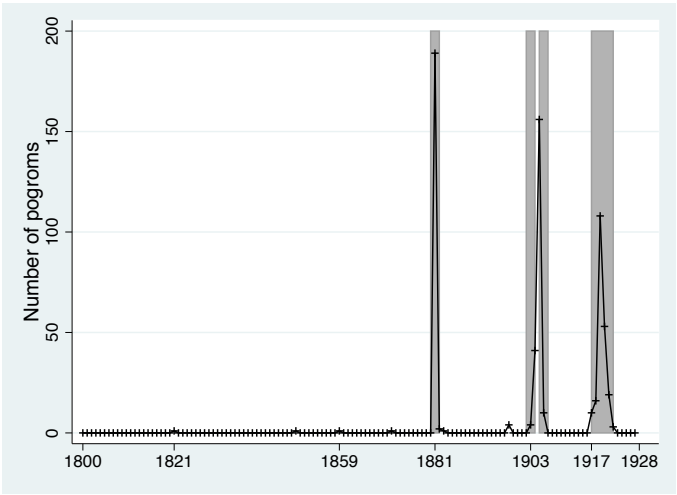
(b) Pogrom occurrence and crop failure



(c) Pogrom occurrence and times of political turmoil



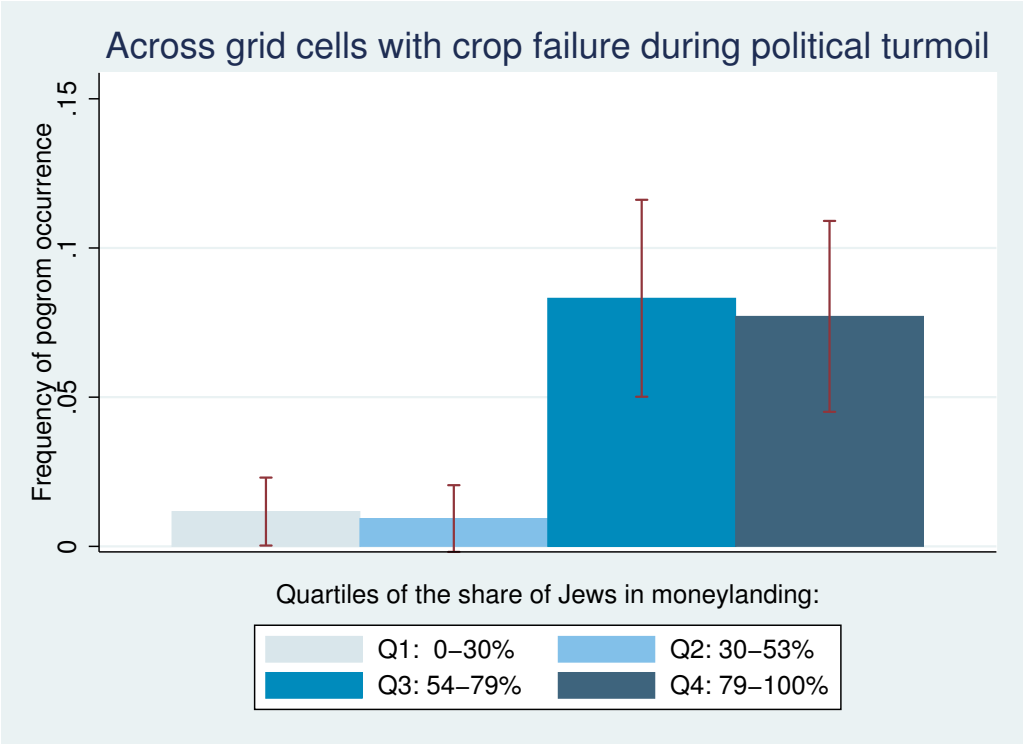
(d) Pogrom occurrence at the intersection of political turmoil with crop failure



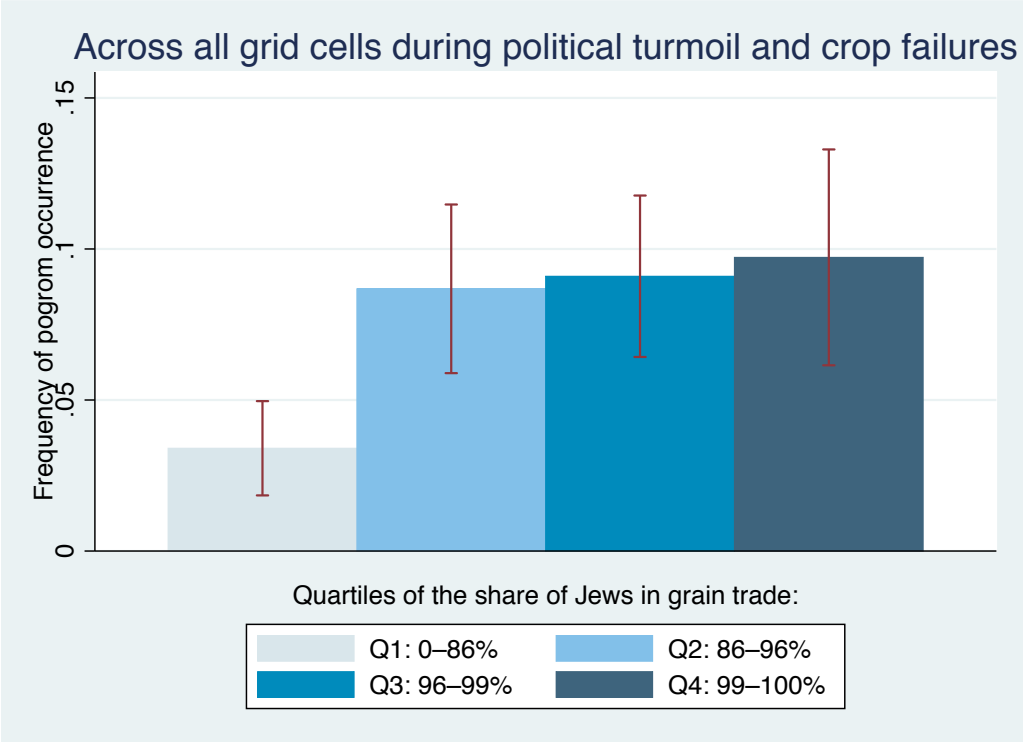
Note: The figure presents the number of pogroms over time in the Pale of Jewish of Settlement. Panel A presents the time series of the number of pogroms. Panel B adds to this time series the shaded periods when at least some geographic areas within the Pale suffered crop failures. Panel C highlights 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

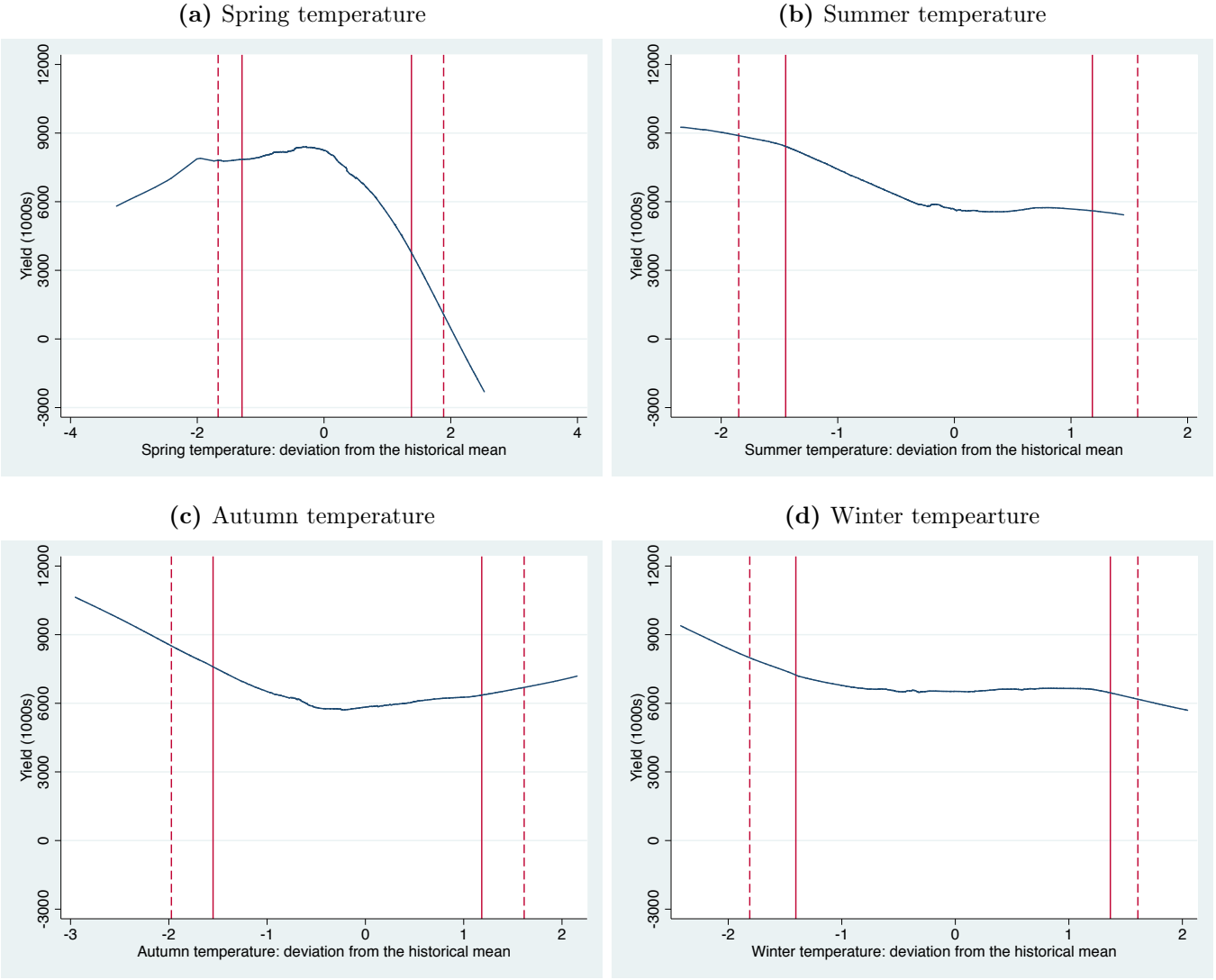


(b) Share of Jews among traders in grain across all localities during political turmoil and global economic shock



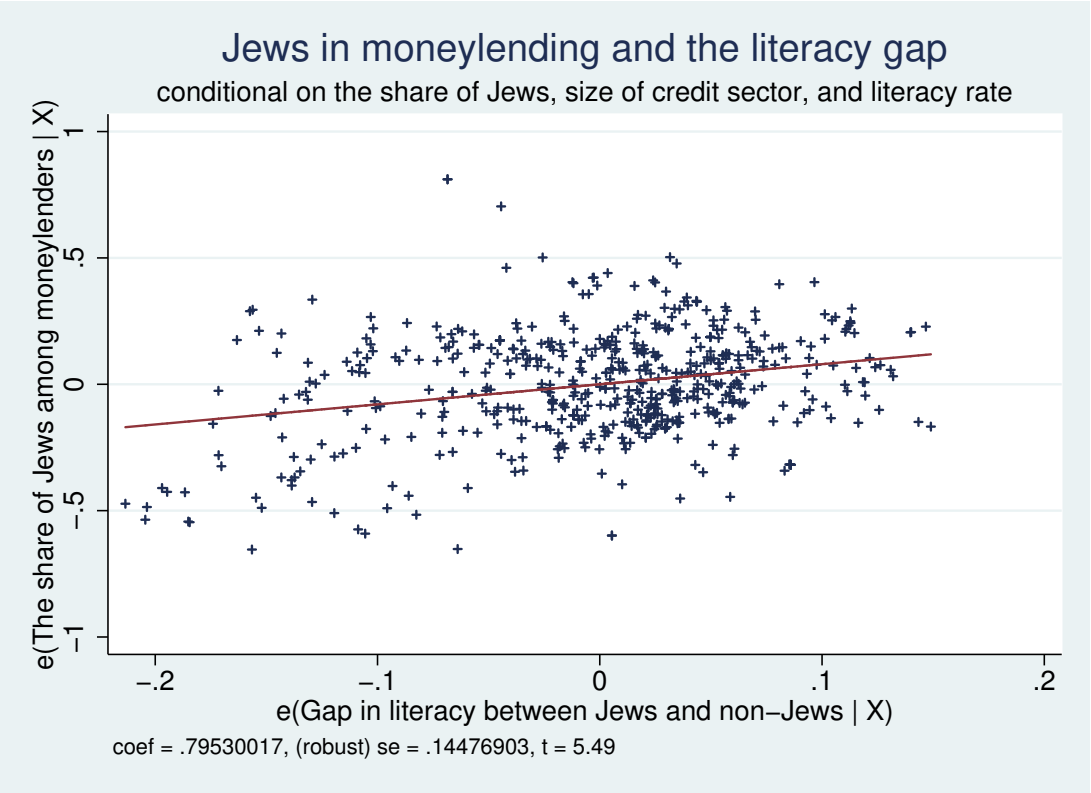
Note: The figure presents the frequency of occurrence of pogroms by quartiles of the share of Jews among moneylenders in grid cells that suffered from a negative agro-climatic shock at times of political turmoil and by quartiles of the share of Jews among traders in grain in all grid cells during political turmoil which coincided with occurrence of crop failures in some localities in the Pale in the same or in the previous year.

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.

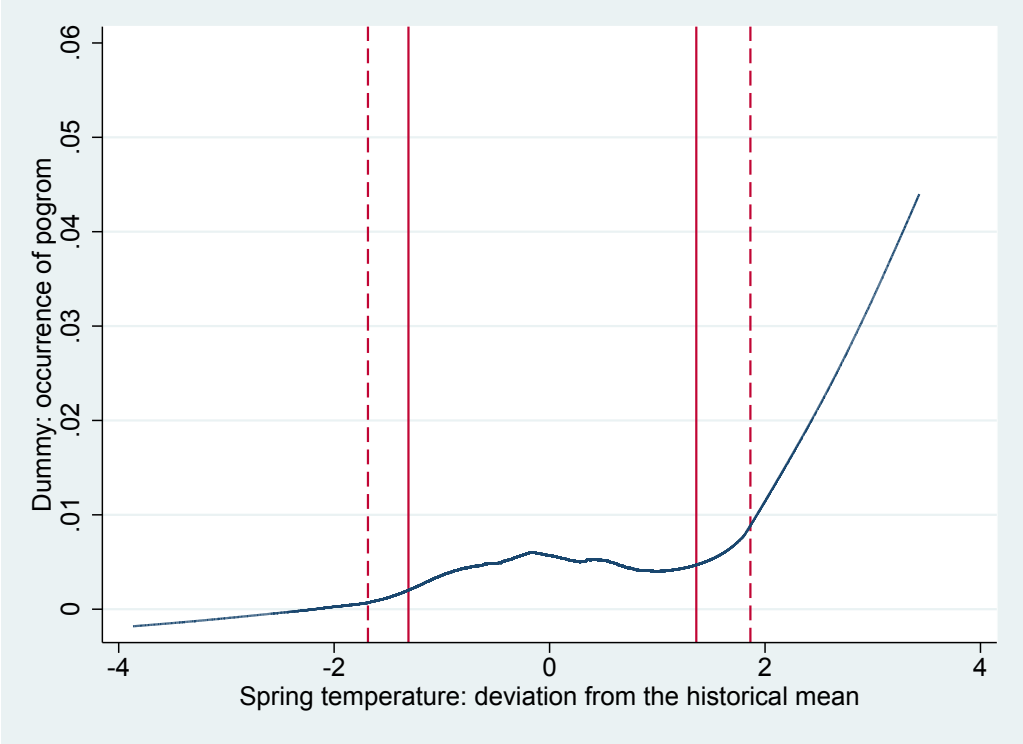
Figure 5: Visualisation of the first stage



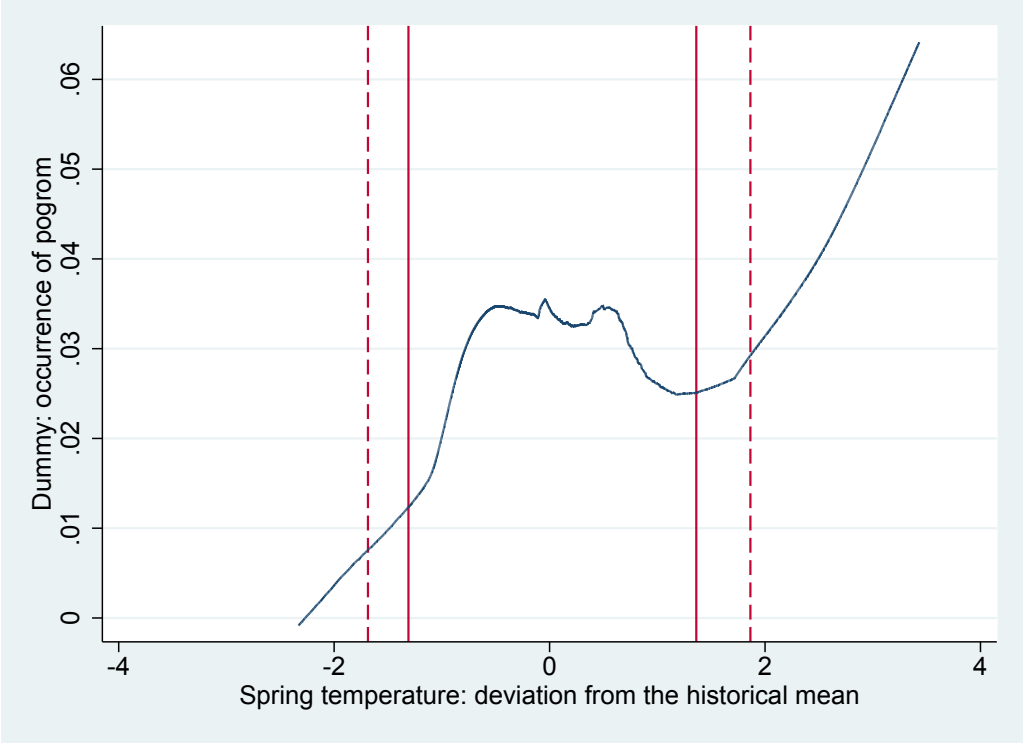
Note: The figure presents the conditional scatter plot, in which the share of Jews in moneylending is related to the gap in literacy between Jews and non-Jews in both the native language and in Russian conditional on the share of Jews, the share of credit in total employment, and total literacy rate.

Figure 6: Pogroms, local economic shocks, and global 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 trade grain	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 $\times$ 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 on the Pale of Settlement. 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 clusters at the province level. *** p<0.01, ** p<0.05, * p<0.1

Table 3: The timing of pogrom occurrence and local economic and global political shocks

	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						
sdev 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)
sdev spring temp. × political turmoil		0.0196**	0.0208**	-0.0030	0.0091**	0.0096**
		(0.0088)	(0.0083)	(0.0020)	(0.0046)	(0.0047)
sdev summer temperature						-0.0001
						(0.0001)
sdev 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 and global political shocks 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 correlation following Hsiang (2010) in a radius of 100 km and 1 temporal lag. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Specialization of Jews in moneylending and pogrom occurrence during local economic and global political shocks, 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 and global political shocks, 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 correlation following Hsiang (2010) in a radius of 100 km and 1 temporal lag. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Instrumental variable estimation: Specialization of Jews in moneylending and pogrom occurrence during local economic and global political shocks, 2SLS

	First stage					
	econ. shock × Jews in credit	pol. turmoil × Jews in credit	econ. shock × pol. turmoil × Jews in credit	Occurrence of pogroms		
				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 and global political shocks, 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 correlation following Hsiang (2010) in a radius of 100 km and 1 temporal lag. *** p<0.01, ** p<0.05, * p<0.1

Table 6: 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 4 and column 5 of Table 5 with additional controls for the interactions of local economic and global political shocks with the shares of Jews in other occupations.

Table 7: Specialization of Jews in 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 and global political shocks 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. Standard errors are corrected for both spatial and temporal correlation 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 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	0.0001				0.0007
	(0.0012)				(0.0010)
political turmoil × Jews in grain trade	0.0075				0.0186
	(0.0114)				(0.0136)
macro econ shock × political turmoil × Jews in grain trade	0.0612**				0.0590**
	(0.0267)				(0.0273)
macro econ shock × Jews in non-agric. trade		-0.0009			-0.0007
		(0.0019)			(0.0016)
political turmoil × Jews in non-agric. trade		-0.0114			-0.0060
		(0.0132)			(0.0171)
macro econ shock × political turmoil × Jews in non-agric. trade		0.0405			0.0199
		(0.0295)			(0.0345)
macro econ shock × Jews in crafts/industry			-0.0005		0.0001
			(0.0025)		(0.0021)
political turmoil × Jews in crafts/industry			-0.0561***		-0.0543***
			(0.0191)		(0.0202)
macro econ shock × political turmoil × Jews in crafts/industry			-0.0154		-0.0291
			(0.0459)		(0.0505)
macro econ shock × Jews in transport				-0.0013	-0.0012
				(0.0013)	(0.0012)
political turmoil × Jews in transport				-0.0190*	-0.0089
				(0.0115)	(0.0129)
macro econ shock × political turmoil × Jews in transport				0.0005	-0.0153
				(0.0238)	(0.0294)
macro econ shock × Jews in credit	-0.0004	-0.0001	-0.0002	0.0000	0.0000
	(0.0008)	(0.0006)	(0.0005)	(0.0006)	(0.0005)
political turmoil × Jews 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	0.0181	0.0178	0.0325*	0.0282*	0.0259
	(0.0167)	(0.0176)	(0.0191)	(0.0159)	(0.0188)
R-squared	0.118	0.116	0.117	0.116	0.119
Panel B: Macro-economic and political turmoil shocks together					
macro econ and political shock × Jews in grain trade	0.0681***				0.0765***
	(0.0241)				(0.0236)
macro econ and political shock × Jews in non-agric. trade		0.0294			0.0138
		(0.0264)			(0.0300)
macro econ and political shock × Jews in crafts/industry			-0.0672		-0.0787*
			(0.0418)		(0.0462)
macro econ and political shock × Jews in transport				-0.0179	-0.0244
				(0.0212)	(0.0268)
macro econ and political shock × Jews in credit	0.0026	0.0063	0.0324*	0.0194	0.0265
	(0.0150)	(0.0157)	(0.0177)	(0.0135)	(0.0170)
R-squared	0.118	0.116	0.117	0.116	0.119
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 marco-economic and global political shocks 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. Standard errors are corrected for both spatial and temporal correlation following Hsiang (2010) in a radius of 100 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

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

	Total population		Jewish population	
Occupation	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

	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. There are 15 provinces on the Pale of Settlement. 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 clusters at the province level. *** p<0.01, ** p<0.05, * p<0.1

Table A5: The robustness of the effect of the share of Jews among moneylenders to alternative assumptions about the variance-covariance matrix (OLS and IV)

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	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 4 and column 5 of Table 5 using alternative assumptions about variance-covariance matrix. *** p<0.01, ** p<0.05, * p<0.1

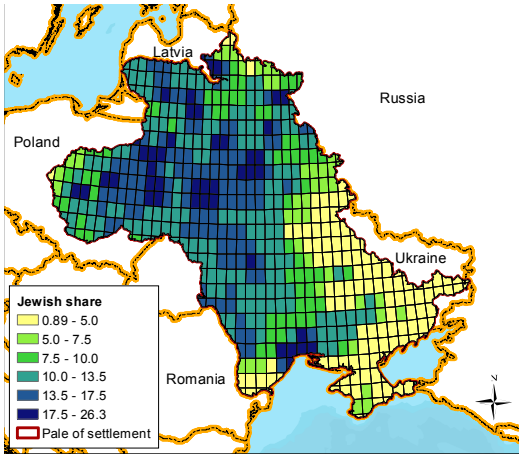
Table A6: The robustness of the effect of the share of Jews among grain traders to alternative assumptions about the variance-covariance matrix (OLS)

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		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 × Jews 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)	(0.0117)
macro shock × political turmoil × Jews in grain trade	0.0612***	0.0612***	0.0612**	0.0612*	0.0612**	0.0612**	0.0612*
	(0.0173)	(0.0194)	(0.0267)	(0.0341)	(0.0267)	(0.0267)	(0.0341)
R-squared	0.118	0.118	0.118	0.118	0.118	0.118	0.118
Panel B: Macro-economic and political turmoil shocks together							
macro econ and political shock × Jews in grain trade	0.0681***	0.0681***	0.0681***	0.0681**	0.0681***	0.0681***	0.0681**
	(0.0155)	(0.0169)	(0.0241)	(0.0320)	(0.0241)	(0.0241)	(0.0320)
R-squared	0.117	0.117	0.117	0.117	0.117	0.117	0.117
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

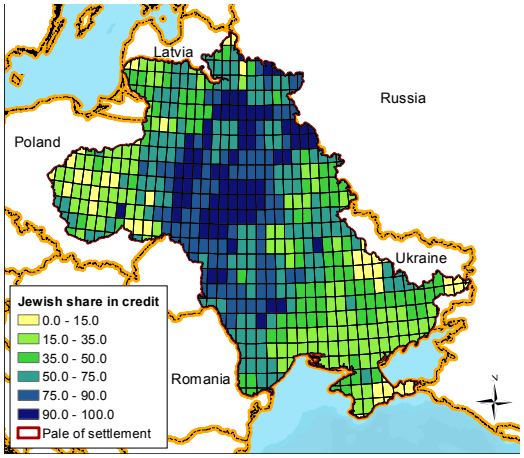
Note: This table reports the results of the specifications presented in column 1 of Table 8 using alternative assumptions about variance-covariance matrix. *** p<0.01, ** p<0.05, * p<0.1

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

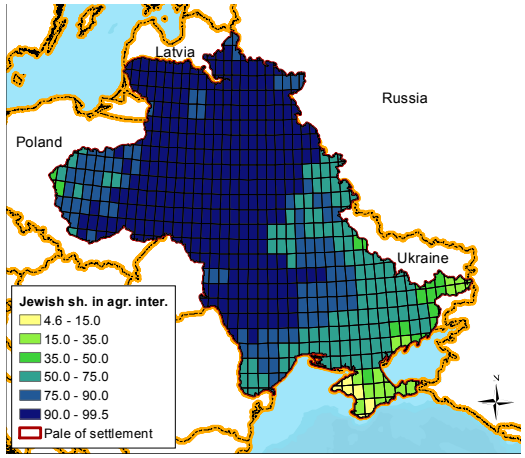
(a) The share of Jews



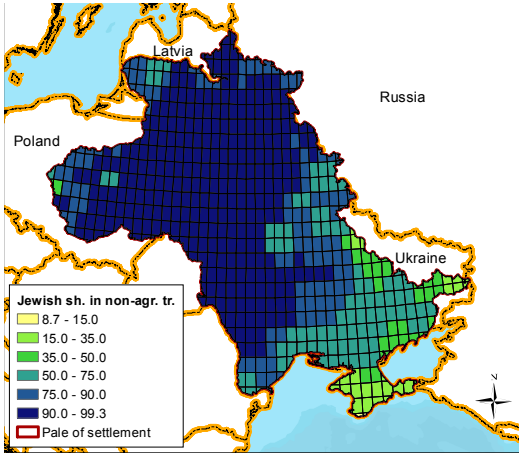
(b) The share of Jews among moneylenders



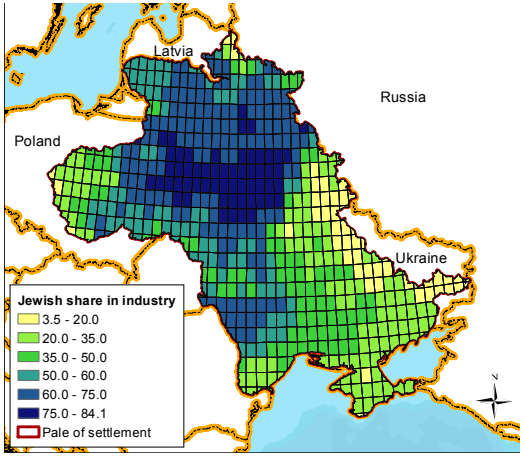
(c) The share of Jews among trades in agricultural goods



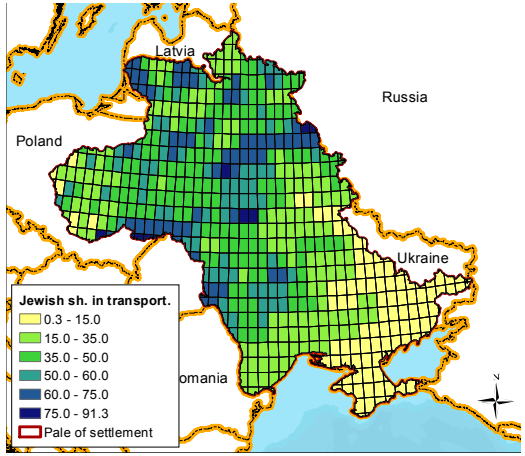
(d) The share of Jews among traders in non-agricultural goods



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

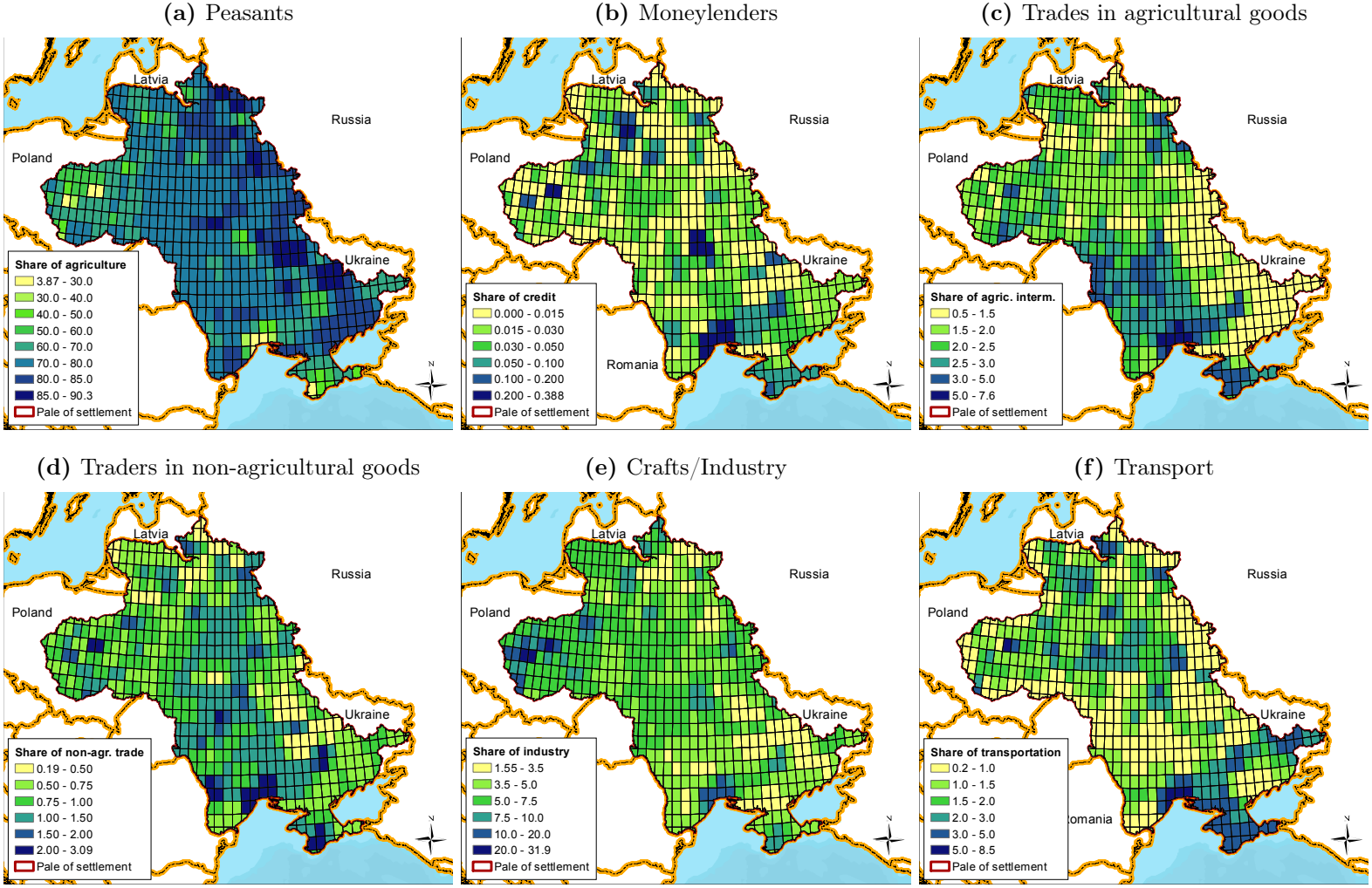


(f) The share of Jews in transport



Note: Source: 1897 census of the Russian Empire.

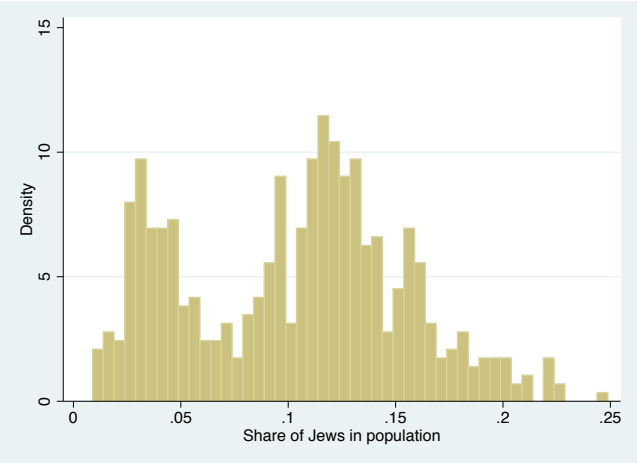
Figure A2: Spatial distribution of the share of different occupations in total employment in 1897



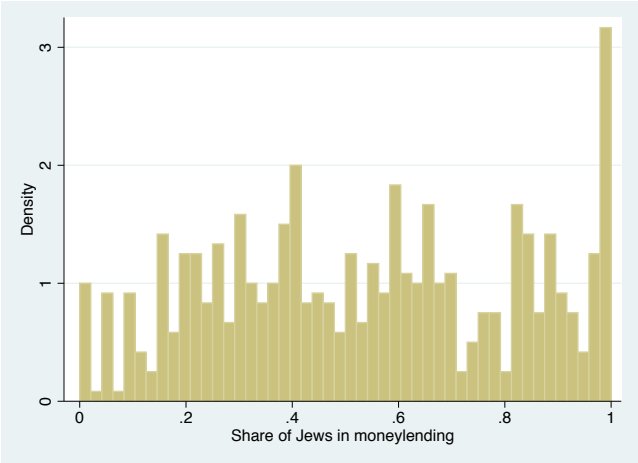
Note: Source: 1897 census of the Russian Empire.

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

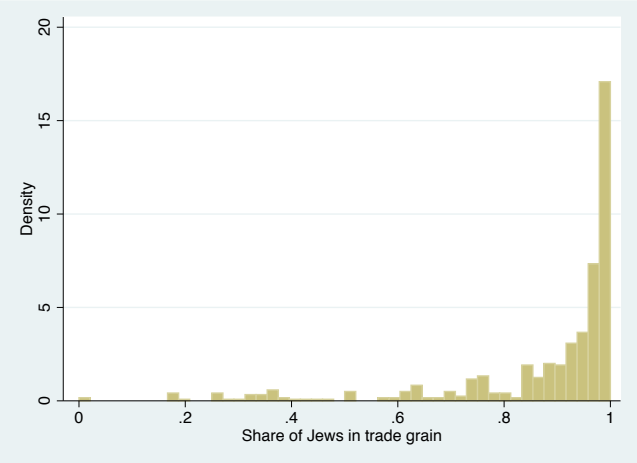
(a) Total



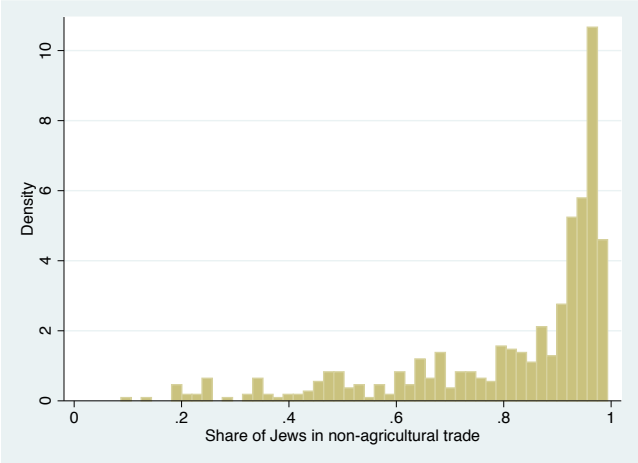
(b) Moneylenders



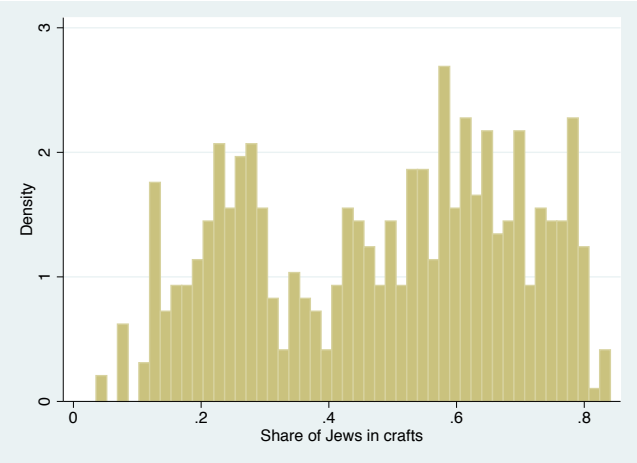
(c) Traders in grain



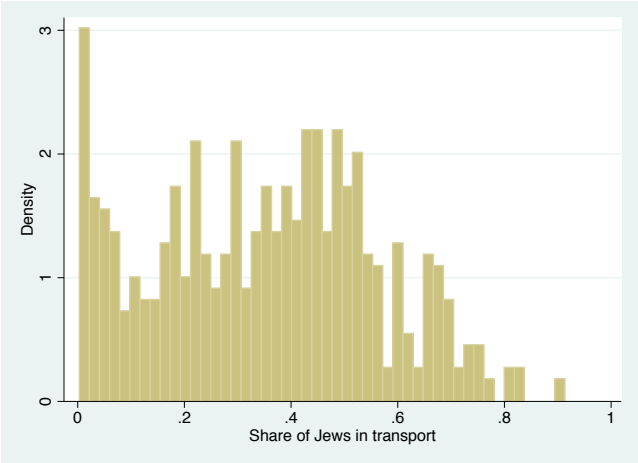
(d) Traders in non-agricultural goods



(e) Employed in crafts/industry



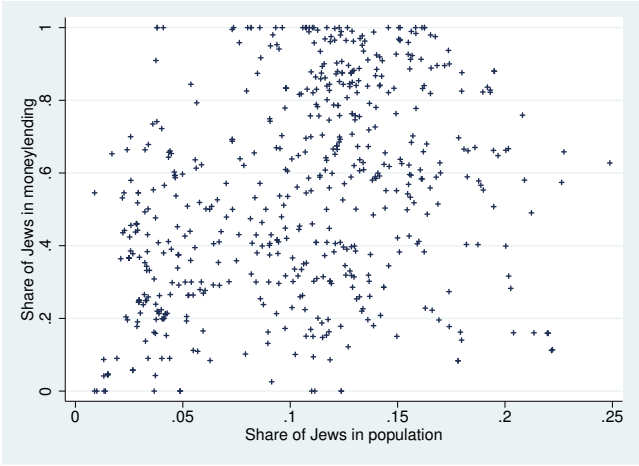
(f) Transport



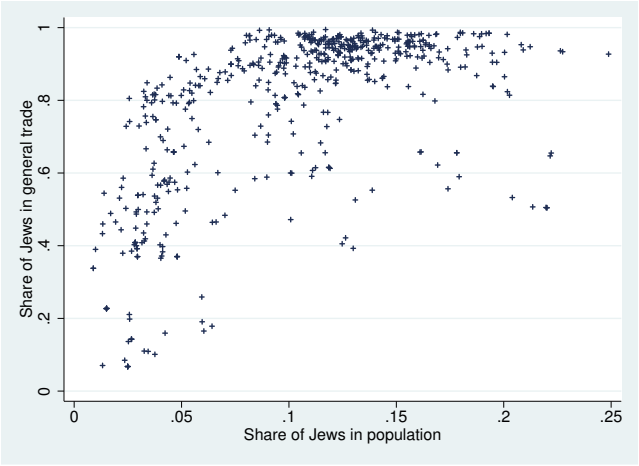
Note: Source: 1897 census of the Russian Empire.

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

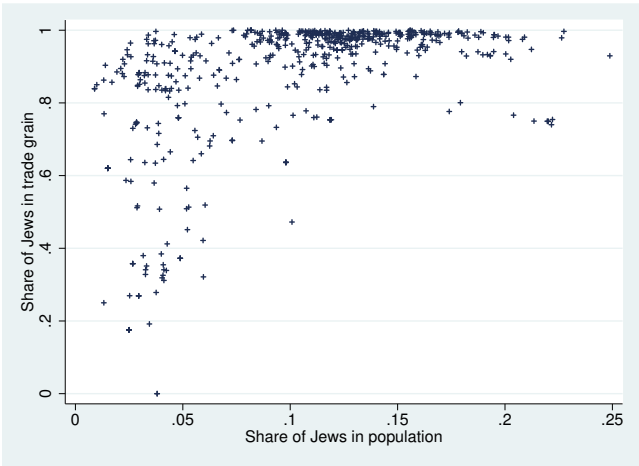
(a) Moneylenders



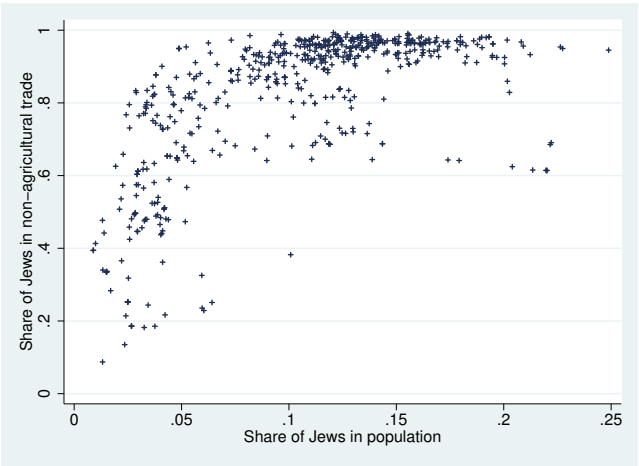
(b) General traders



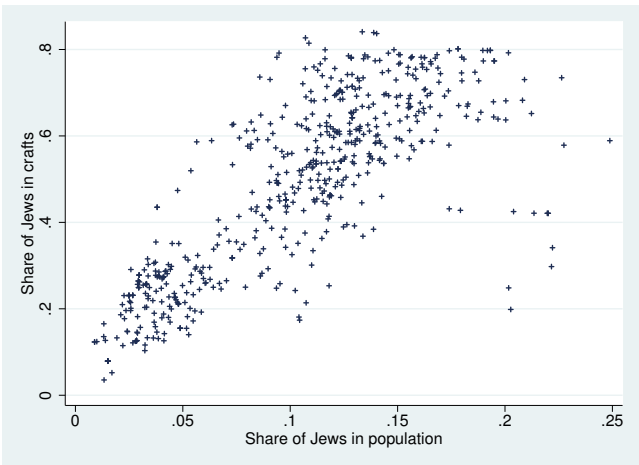
(c) Traders in grain



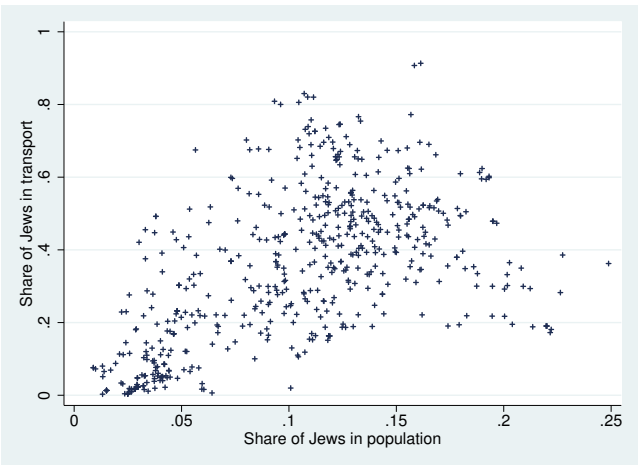
(d) Traders in non-agricultural goods



(e) Employed in crafts/industry



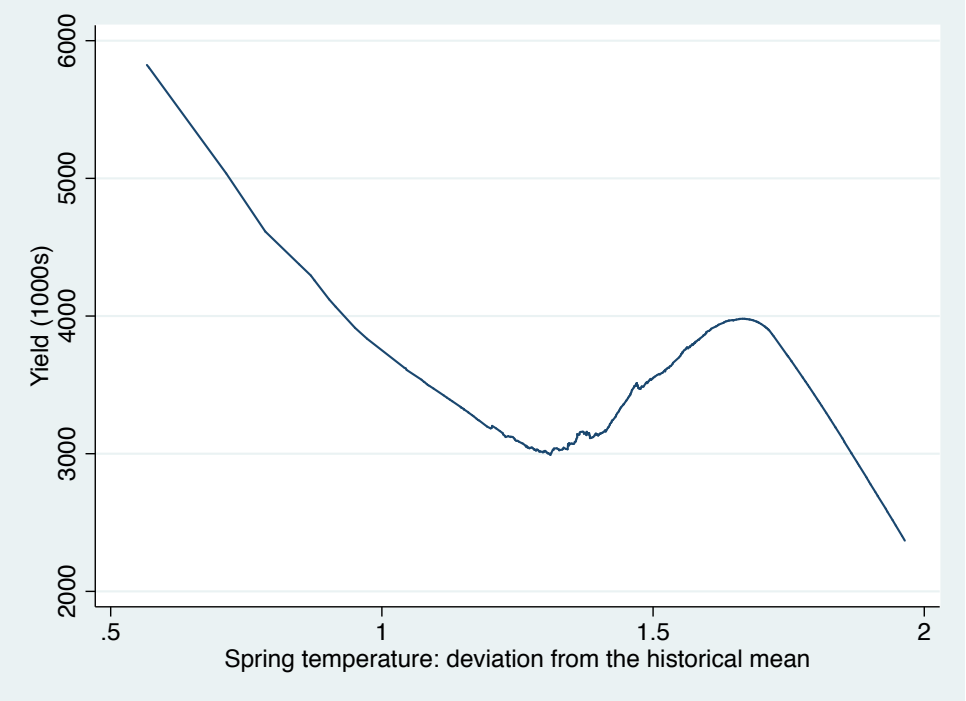
(f) Transport



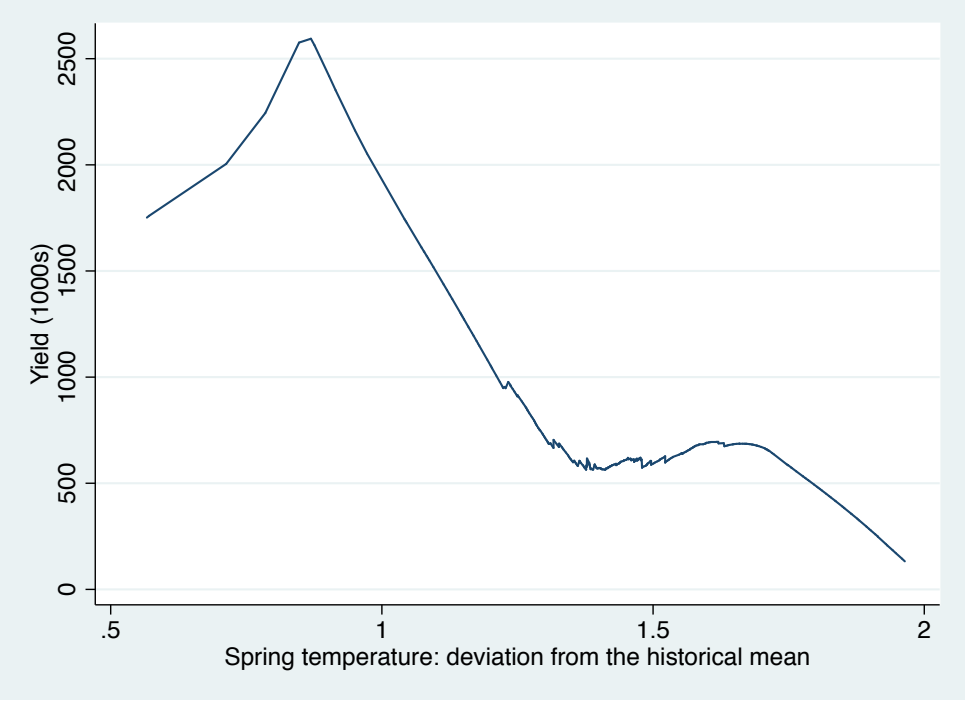
Note: Source: 1897 census of the Russian Empire.

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

(a) Winter grains

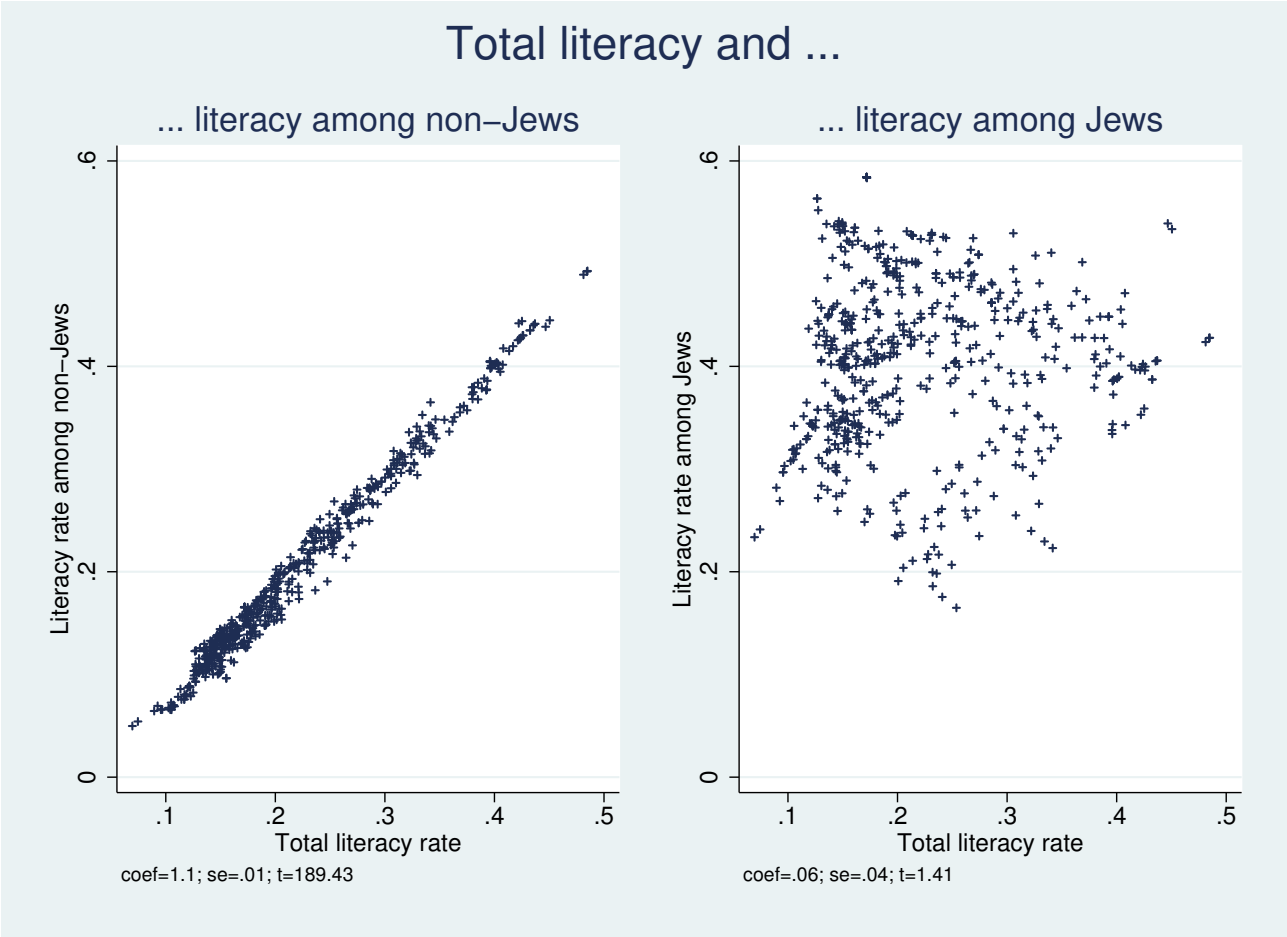


(b) Spring grains



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.

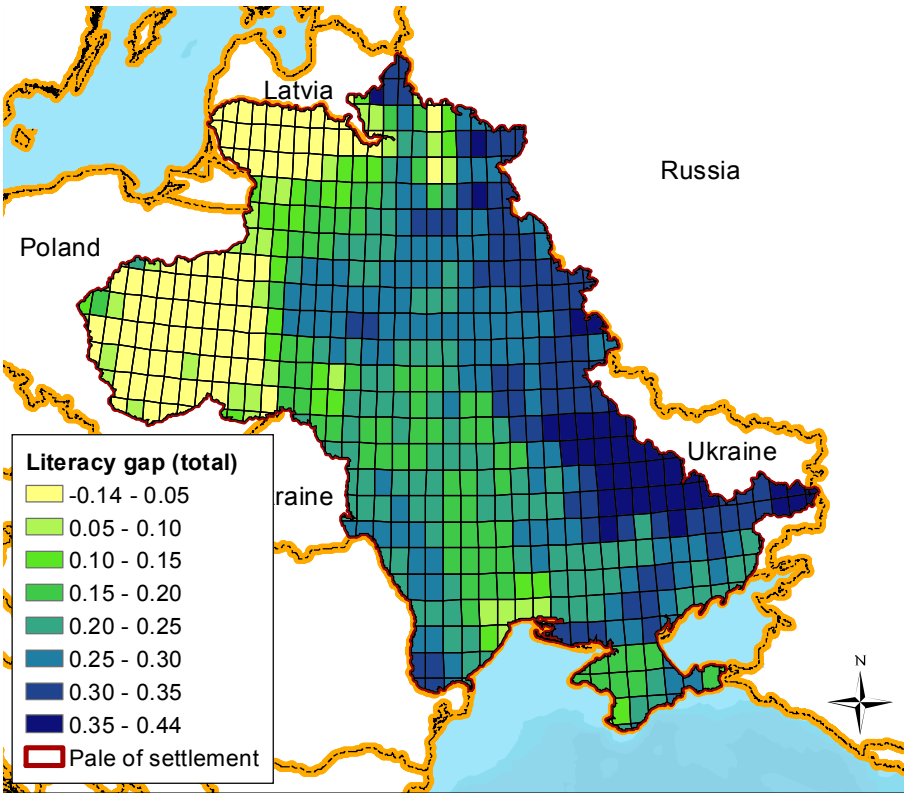
Figure A6: Total literacy rate is uncorrelated with the literacy of Jews



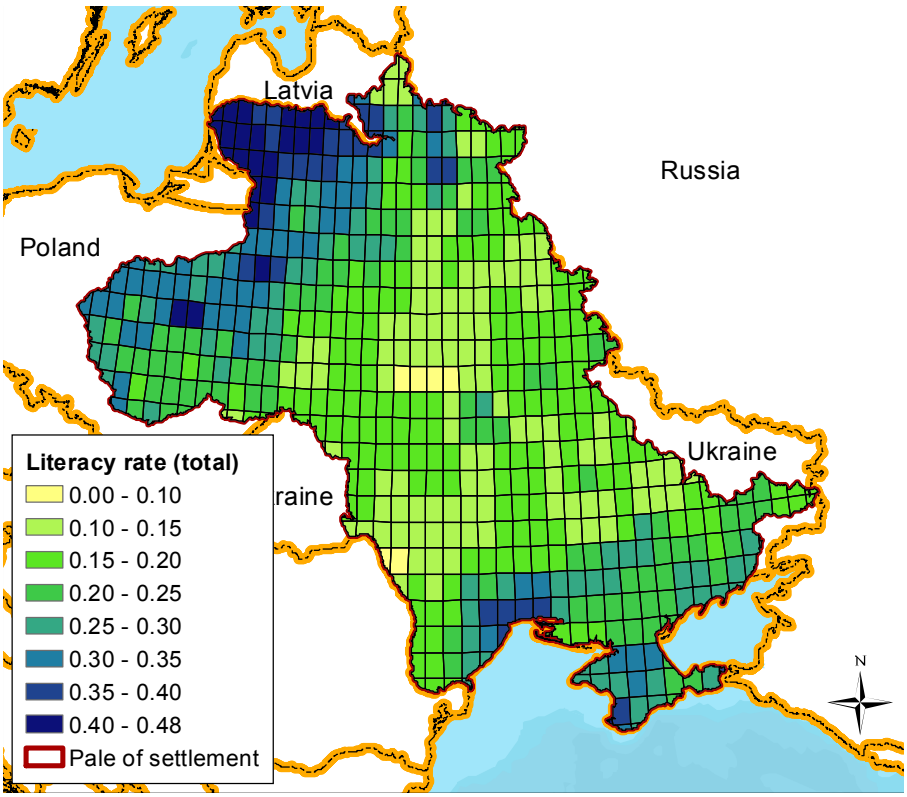
Note: The figure presents the unconditional scatter plots, in which the total literacy rate is related to the literacy of non-Jews (left plot) and to the literacy of Jews (right plot).

Figure A7: Literacy in 1897

(a) Literacy gap between Jews and non-Jews



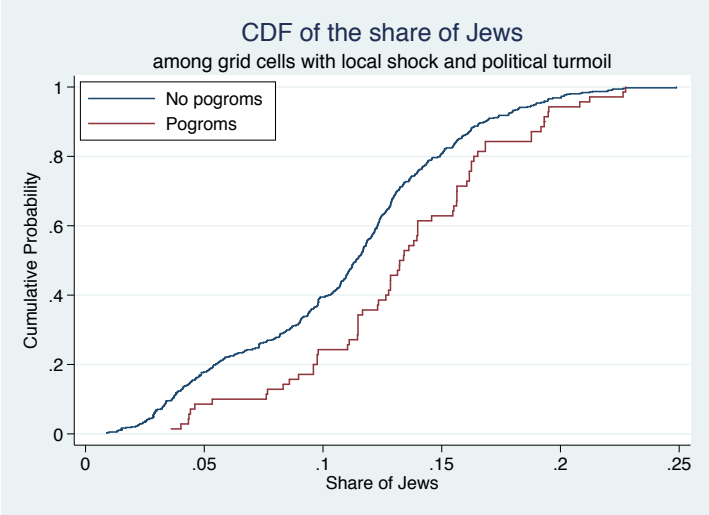
(b) Total literacy rate



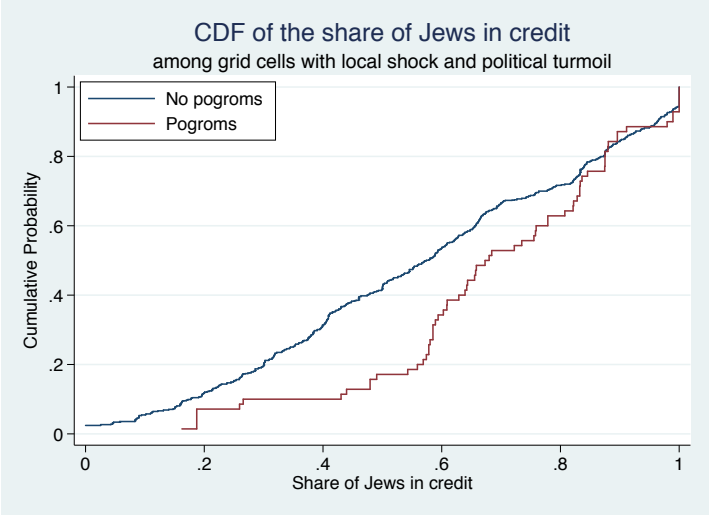
Note: Source: 1897 census of the Russian Empire.

Figure A8: Cumulative distribution functions

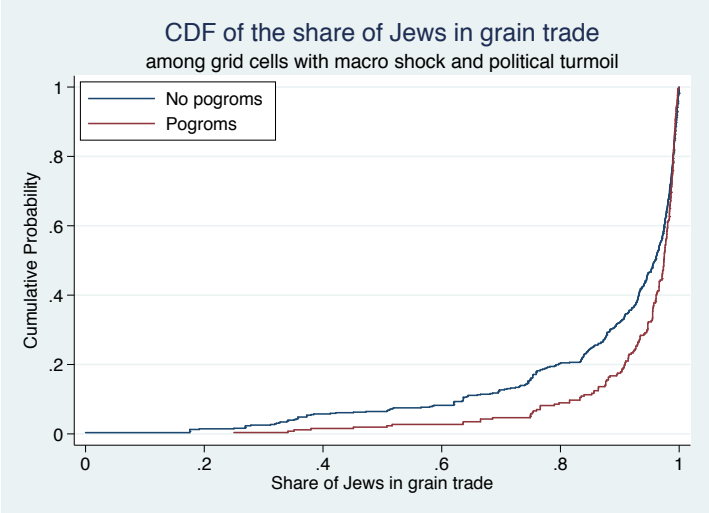
(a) The share of Jews



(b) The share of Jews among moneylenders



(c) The share of Jews among grain traders



Note: The figure presents 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.

B Sources used to compile data on pogroms

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- *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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- Klier, John D. and Shlomo Lambroza (1992). *Pogroms: Anti-Jewish Violence in Modern Russian History*, Cambridge University Press, New York.
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- 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

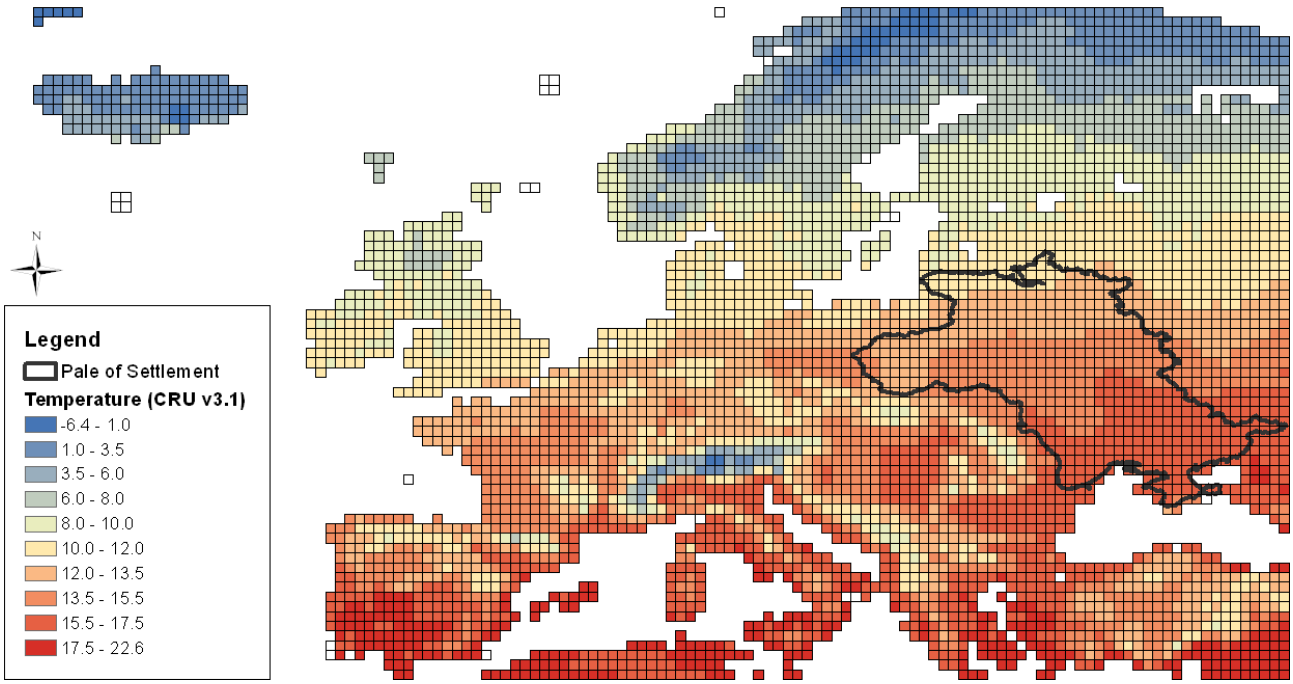
C Correcting for the discrepancy in spring temperature in 1881 and 1882

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 for every one 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.

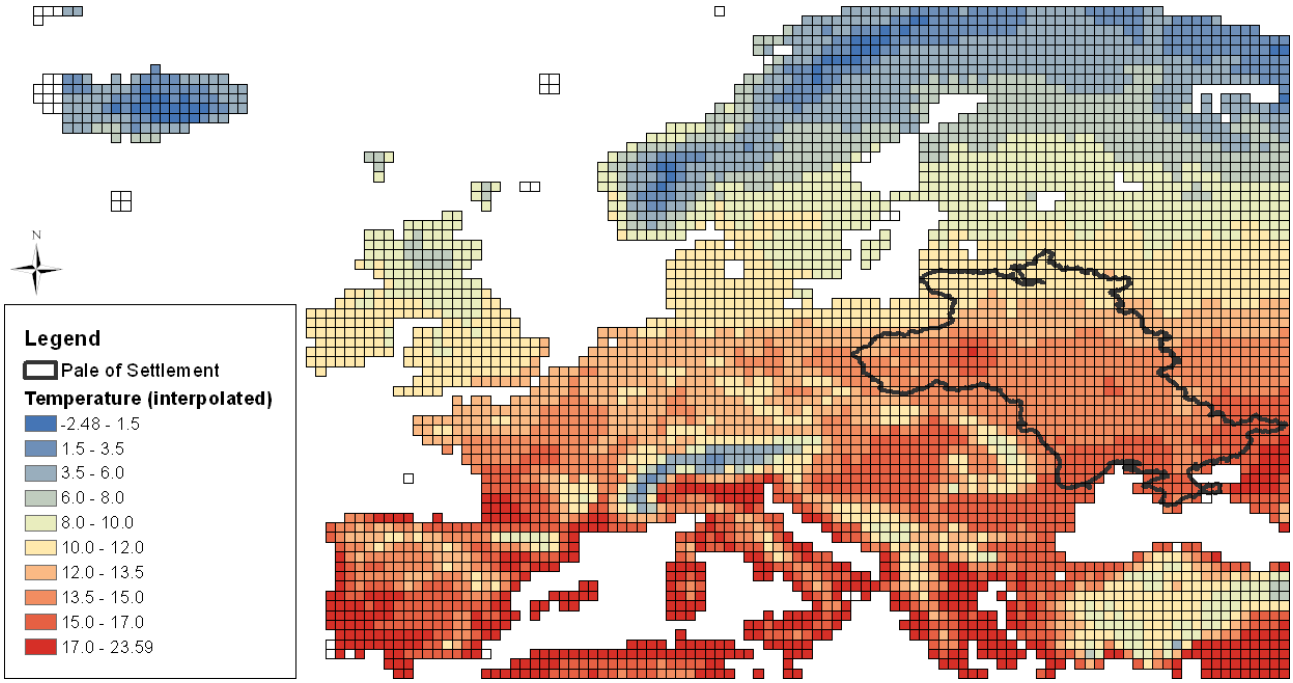
To check our interpolation quality, we perform this procedure not only for 1881 and 1882, but also for the 1900–2000 period and match it to the CRU TS v3.1 dataset. CRU TS is the most commonly employed global gridded climate data set and reconstructed historical seasonal temperature data by Luterbacher 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 shown 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