THE ECONOMIC JOURNAL

The Economic Journal, **127** (*June*), 924–958. Doi: 10.1111/ecoj.12331 Published by John Wiley & Sons, 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main Street, Malden, MA 02148, USA.

JEWISH PERSECUTIONS AND WEATHER SHOCKS: 1100–1800*

Robert Warren Anderson, Noel D. Johnson and Mark Koyama

What factors caused the persecution of minorities in pre-modern Europe? Using panel data consisting of 1,366 persecutions of Jews from 936 European cities between 1100 and 1800, we test whether persecutions were more likely following colder growing seasons. A one standard deviation decrease in growing season temperature in the previous five-year period increased the probability of a persecution by between 1 and 1.5 percentage points (relative to a baseline of 2%). This effect was strongest in weak states and with poor quality soil. The long-run decline in persecutions was partly attributable to greater market integration and state capacity.

Throughout most of history, religious minorities were the victims of persecution. Violence against religious and ethnic minorities remains a major problem in many developing countries today (Horowitz, 2001; Chua, 2004; Yanagizawa-Drott, 2015). In contrast, religious persecution in the developed world is much less common than it used to be.[1] This article investigates why some states persecuted minorities more than others in pre-industrial Europe and why this persecution gradually decreased between 1500 and 1800.

To answer these questions, we focus on the persecution of the Jews in medieval and early modern Europe. Violence against Jews was caused by many factors, including religiously motivated antisemitism. We choose, however, to build on the claim advanced by historians that Jews were convenient scape-goats for social and economic ills.[2] To test this hypothesis, we exploit variation in reconstructed city-level temperature to investigate whether persecutions against Jews were associated with colder temperatures. We do this using panel data comprising 1,366 city-level persecutions of Jews

* Corresponding author: Mark Koyama, Center for Study of Public Choice, Carow Hall, George Mason University, VA 22030, USA. Email: mark.koyama@googlemail.com.

We are grateful to Megan Teague and Michael Szpindor Watson for research assistance. We benefited from comments from Martin Cripps, four anonymous referees as well as Ran Abramitzky, Daron Acemoglu, Quamrul Ashraf, Dean Phillip Bell, Pete Boettke, Tyler Cowen, Carmel Chiswick, Melissa Dell, Dan Bogart, Markus Eberhart, James Fenske, Joe Ferrie, Raphäel Franck, Oded Galor, Avner Greif, Philip Hoffman, Larry Iannaccone, Remi Jedwab, Garett Jones, James Kai-sing Kung, Pete Leeson, Yannay Spitzer, Stelios Michalopoulos, Naomi Lamoreaux, Jason Long, David Mitch, Joel Mokyr, Johanna Mollerstrom, Robin Mundill, Steven Nafziger, Jean-Laurent Rosenthal, Jared Rubin, Gail Triner, John Wallis, Eugene White, Larry White and Ekaterina Zhuravskaya. We thank seminar participants at Chapman University, George Mason University, King's College, London, Stanford University, the Elliott School for International Affairs, the 2013 All UC Conference, the Clio World Congress at the University of Hawaii, Rutgers University, Northwestern University, the Conference on Diversity and Culture sponsored by HSE, Moscow, the Deep Determinants of Economic Growth Conference at Brown and Colby College. All remaining errors are the fault of the authors. We are grateful to Jane Perry for proof-reading the article.

[1] Excepting, of course, the large-scale killings associated with the genocides of the mid-twentieth century. The decline in religious persecution is especially evident when measured on a *per capita* basis. For a detailed discussion of the decline of mass killings and persecutions over time see Pinker (2011).

[2] Important historical contributions include Baron (1965*a*, *b*, 1967*a*, *b*, 1975); Chazan (2006, 2010); Israel (1985); Jordan (1989, 1998); Mundill (1998, 2010); Poliakov (1955); Richardson (1960); Roth (1961); Stow (1981, 1992) and many others.

from 936 European cities that are recorded as having Jewish populations between the years 1100 and 1800 in the 26-volume *Encyclopaedia Judaica* (2007) and data on yearly growing season temperature (April to September) constructed by Guiot and Corona (2010).

We find that a one standard deviation decrease in average growing season temperature (about one-third of a degree celsius) raised the probability that a community would be persecuted from a baseline of about 2% to between 3% and 3.5% in the subsequent five-year period. This effect is larger in cities with poor quality soil and with weak states.

To clarify our empirical analysis, we develop a conceptual framework that outlines the political equilibrium under which pre-modern rulers would tolerate the presence of a Jewish community. We show why this equilibrium was vulnerable to shocks to agricultural output and why this vulnerability may have been greater in locations with poor quality soil and in weak states that were more susceptible to popular unrest. Consistent with our theoretical framework, we find the empirical relationship between temperature shocks and persecutions was strongest in regions controlled by weak states and with poor soil quality.

A growing literature attributes the emergence of modern political and economic institutions to the transition from closed to open access institutions between 1500 and 1800 (North *et al.*, 2009; Acemoglu and Robinson, 2012). We provide new evidence concerning this transition. In extractive societies, toleration for minority groups was always conditional; negative economic shocks led to the unraveling of this toleration and to persecutions and expulsions. Our analysis shows that the relationship between negative economic shocks and the persecution of Jews was weaker in stronger states and diminished as markets became better integrated. We support these results with extensive narrative evidence consistent with the hypothesis that more centralised states as well as better integrated markets played an important role in reducing the vulnerability of minority groups to economic shocks and in shaping Europe's gradual transition from closed to open-access institutions.

We follow a number of papers that use weather to identify the impact of economic shocks on violence and conflict in pre-industrial or developing economies. Oster (2004) finds that cold weather shocks were associated with witchcraft trials in early modern Europe. Miguel (2005) finds that extreme levels of precipitation were associated with a higher number of witchcraft deaths in modern Tanzania. In a historical context, both Zhang *et al.* (2006) and Tol and Wagner (2010) find a connection between colder weather and warfare in pre-industrial China and Europe respectively. Bai and Kai-sing Kung (2011) examine the relationship between climate and conflicts between nomads and the state on the borders of pre-modern China. Jia (2014) examines the effect weather-induced harvest failure had on civil conflict and revolts in Imperial China. Chaney (2013) provides evidence that sharp deviations in the Nile floods strengthened the power of religious leaders who could threaten the political authorities with revolt. Fenske and Kala (2013) show that positive climate shocks (a decrease in temperature in this context) in sub-Saharan Africa increased slave exports and thus had a perverse effect on economic performance and welfare.[3] Waldinger (2014) uses temperature data similar to those we employ to study the effect of colder temperatures between 1500 and 1750 on urban growth in Europe.

By establishing temperature shocks as a potential trigger for persecutions of Jews in pre-industrial Europe, our findings also complement two important recent contributions on the persistence of antisemitic attitudes: Voigtländer and Voth (2012) and Grosfeld *et al.* (2013). Voigtländer and Voth (2012) use data from the massacres that followed the Black Death to establish the persistence of antisemitic cultural traits at the local level in Germany. They show these cultural factors were an important precondition for antisemitic violence in the 1920s and for support for the Nazi party. Grosfeld *et al.* (2013) examine the persistence of anti-market sentiments in Imperial Russia's Pale of Settlement where Jews were confined from the end of the eighteenth through to the early twentieth century. They argue that within the Pale, non-Jews developed a set of anti-Jewish and anti-market values which have persisted to this day. Our findings are complementary to these studies as we shed light on the timing and causes of antisemitic violence across Europe between 1100–1800.[4] We delineate the circumstances under which negative supply shocks were more likely to trigger expropriations and expulsions in societies that were permeated with antisemitism and thus contribute to a growing literature on the causes of persecution.[5]

Finally, our findings are related to a growing literature on the economic history of the Jews in medieval and early modern Europe. Barzel (1992) and Koyama (2010*b*) study why the Jews were expelled from medieval England. Pascali (2015) examines the consequences of Jewish expulsions from Italy in the early modern period. He finds that cities that had either Jewish pawn banks or *Monti di Pietà* charitable Christian lending institutions are significantly more financially developed today while those parts of Italy that were ruled by Spain and expelled their Jewish communities in 1541 remain comparatively underdeveloped. Botticini and Eckstein (2012) provide a novel explanation for why Jews specialised as moneylenders during the middle ages. Our theoretical and empirical results complement their account by explaining why this

[3] Dell *et al.* (2014) surveys the literature on climate and economics. Hsiang and Burke (2014) and Hsiang *et al.* (2013) survey a range of quantitative studies that find a causal link between climate change and social conflict. Madesam *et al.* (2013) find that weather has an effect on the ability of political groups in the modern US to organise. In addition, there are several recent papers which investigate the effect of weather on economic outcomes. For example, Jones and Olken (2010) look at the effect of weather on exports, Maccini and Yang (2009) investigate the effect of weather shocks on children's health, and Dell *et al.* (2012) investigate the negative effects of warm temperatures on developing economies. Durante (2009) explores the relationship between climatic variability in the past and trust today across European countries. Anderson (2012) finds that lower temperatures were associated with more sentences being passed down by the Portuguese Inquisition.

[4] Antisemitism is a nineteenth century term. Nevertheless, following Langmuir (1990), it has also been used by medieval historians to describe the rise of virulent anti-Jewish hatred and violence after 1100, a development that was based upon a common set of tropes, which sought to blame Jews for personal misfortunes and tragedies (i.e. in the case of ritual murder accusations) or for general social ills (i.e. in the charges of host desecration, well poisoning, coin-clipping or diabolism). See Moore (1992, pp. 42–3) and Stacey (2000, pp. 163–6).

[5] For example, Glaeser (2005) studies the incentives politicians have to incite hatred against particular groups; Mitra and Ray (2013) provides a theory of ethnic conflict and applies it to Hindu-Muslim violence in India; Johnson and Koyama (2014*b*) examine the relationship between the rise of the French state and the decline in trials for witchcraft; Vidal-Robert (2013) studies what factors were associated with more trials by the Spanish Inquisition; and Acemoglu *et al.* (2011) estimate the economic costs of the Holocaust in Russia.

specialisation, despite making Jews especially valuable to medieval rulers, ultimately placed Jewish communities in a political equilibrium in which they were vulnerable to persecution and expulsion.

1. Weather Shocks and Jewish Persecutions

Jews in early medieval Europe specialised as merchants and moneylenders (Botticini and Eckstein, 2012, pp. 153–200). Rulers encouraged Jewish settlement in order to promote economic development. The Bishop of Speyer in 1084 wrote: 'When I wished to make a city out of the village of Speyer, I Rudiger, surnamed Huozmann, bishop of Speyer, thought that the glory of our town would be augmented a thousandfold if I were to bring Jews' (quoted in Chazan, 2010, p. 101).

A political equilibrium emerged that enabled European rulers to benefit financially from the presence of Jewish communities but which left the Jews themselves vulnerable to persecution and the threat of expulsion. Over time, Jews specialised as moneylenders (Botticini and Eckstein, 2012, pp. 201–47).[6] Jewish usury was frequently condemned by the Church but it was promoted by secular rulers both because credit was understood to be crucial to the medieval economy and because it provided rulers with an accessible tax base. The Diet of Mainz proclaimed that, 'as loans are necessary and Christians prohibited to lend on profit, the Jew must be allowed to fill the gap' (Stein, 1956, p. 144).[7]

As outsiders in a society that defined itself in opposition to unbelievers, Jews aroused suspicion from others.[8] But it was in the long-run interest of secular rulers to protect their Jewish communities. According to medieval political theory: Jews were serfs of the exchequer because, in return for protection against violence, they had submitted to the king and could therefore be taxed at his discretion (Baron, 1967*b*). Rulers exploited Jews as 'fiscal sponges' to use a contemporary metaphor: 'No sooner did they suck up the money [from the population through their usury], than the overlords proceeded to squeeze it out of them into their own pockets' (Baron, 1967*b*, p. 199).[9] The major problem with this arrangement was that medieval rulers struggled to make credible commitments. They were often unable to protect Jewish communities

[6] See Baron (1967*b*, p. 135). Emery (1959); Lipman (1967); Mundill (1991) and Botticini (1997) provide excellent empirical studies of how medieval Jewish moneylenders operated. For analysis of the tightening of the usury prohibition see Chazan (1973–74) and Koyama (2010*a*).

[7] As Baron (1967*b*, p. 198) wrote: 'Many Jews and Christians alike realised that, next to the religious tradition, the main reason for the former's toleration in western lands was the rulers' self-interest in the revenue derived from them'.

[8] See Moore (2008, pp. 26–42). This hostility could manifest itself among elite groups as well as among peasants. In Renaissance Italy, Jewish moneylenders lent to the poor and were often championed by them, and were typically, instead, opposed by city elites (Botticini, 2000). It is important to stress that we do not attempt to provide an economic or rational choice explanation for the virulent antisemitism that emerged in medieval Europe and that had a variety of sources (Trachtenberg, 1943; Voigtländer and Voth, 2012). For example, Menache (1985, 1997) analyses the importance of the blood libel myth in generating an atmosphere conducive to expulsion. What we do attempt to explain is why negative economic shocks led to the expulsion and expropriation of Jewish communities in some polities but not in others.

[9] In France, this implicit agreement first appears to have been stated in 1198 when the Jews were readmitted into the Royal Domain by Philip Augustus (Moore, 2008, p. 41). In England, where it was perhaps most fully developed, it followed the massacres of Jews in York and the establishment of the Exchequer of the Jewry in 1194 (Cramer, 1940; Stacey, 1985 1995; Dobson, 2003; Brown and McCartney, 2005; Koyama, 2010*b*).

from unrest or antisemitic violence and frequently faced the temptation to expropriate Jewish communities for short-term gain.

The Pastoureaux or Shepherds' Crusade of 1320 illustrates how temperature shocks disrupted the political equilibrium that protected Jews in the medieval states. The Jews were allowed to resettle in France in 1315 on the condition that they act as moneylenders and fiscal agents for the crown. Unfortunately, a succession of disastrous harvests ensued between 1315 and 1321. Campbell describes this as possibly 'the single worst subsistence crisis, in terms of relative mortality, in recorded European history' (Campbell, 2010, p. 7).[10] These shocks produced civil unrest across swathes of northern Europe. In France, a movement arose known as the *Pastoureaux*. The *Pastoureaux* first attacked royal castles in Normandy and the Paris region, then they moved south where they persecuted Jews throughout Languedoc in cities like Saintes, Verdun, Grenade, Castelsarrasin, Toulouse, Cahors, Lézat, Albi, Auch, Rabastens and Gaillac (Barber, 1981*a*, p. 12). The 'brunt of peasant violence fell upon the Jews, for they ... could be blamed for the economic hardships which the lower classes had recently been suffering' (Barber, 1981*b*, p. 163).[11]

The king protected the Jews where possible but massacres occurred wherever royal authority was weak. This example illustrates the connection between a subsistence crisis, political unrest and antisemitic violence in a state that was unable to protect its Jewish minority. There are many other examples of persecutions that follow this pattern of weak polities being unable to credibly commit to their agreements with Jewish communities in the face of economic shocks. In the next Section, we develop a framework that clarifies the mechanisms that connected temperature shocks to subsistence crises and political unrest and then to antisemitic violence.

2. A Conceptual Framework

In this Section, we develop a simple framework to explore the relationship between colder temperature, income shocks, state capacity, and persecutions. Standard models of autocratic states struggle to explain why rulers would ever expel or destroy a valuable fiscal resource like the Jews. To understand why expulsions occurred, therefore, we need to consider cases where the sovereign cannot credibly commit to protect a vulnerable minority.[12]

[10] It was followed by the so-called Great Bovine Pestilence, which wiped out 60% of livestock on the continent (Slavin, 2012).

[11] Tension had been building for sometime as a result of the poor harvests and the peasants undertook religious demonstrations and parades aimed at ending the famine (Barber, 1981*b*, pp. 162–3). Contemporaries also mention that they were incited by debtors of the Jews (Barber, 1981*b*, p. 146). Nirenberg argues that 'the shepherds and the townspeople who supported them' understood this relationship, and 'recognised that the heavy taxes placed on Jews were a form of indirect taxation on Christians' (Nirenberg, 1996, p. 48). When the *Pastoureaux* attacked Jews and looted their possessions in face of the royal attempts to protect them 'they were both attacking a much-resented aspect of administrative kingship and dramatising the state's inability to protect its agents, the Jews' (Nirenberg, 1996, p. 50). Note that this is an instance of peasants attacking Jews; in other cases, towns people targeted the Jews. This means that it is difficult to generalise about which economic strata would have the strongest incentive to expropriate the Jewish community in the event of a negative shock to the agrarian economy.

[12] We build on the reasoning developed by Acemoglu (2003) in our assumption that the Jewish community cannot make a Coasian bargain with the ruler in order to avoid persecution.

Consider an economy in which agriculture is the predominant source of income. Agricultural output is a function of temperature as well as social quality, labour inputs and a host of other variables. In Europe colder growing season temperatures reduce agricultural output. In particular, several successive years of below optimal temperature could cause significant hardship and pressure on resources, especially if a dearth caused peasants to consume their seed-corn. We will refer to such episodes as temperature shocks.[13] In sub-Saharan Africa high temperatures adversely affect agricultural output but, in Europe, wheat and other grains can survive cold winter temperatures but are strongly affected by cold and wet weather during the growing season.[14]

We assume that the Jews play an important role in the commercial sector of the economy and that they are a valuable source of revenue to the ruler. In normal times, therefore, the ruler imposes a tax on the Jewish community that maximises discounted future tax revenue subject to the costs of collection and enforcement. In exchange for these taxes, he promises to offer protection to the Jewish community from either elite or popular antisemitism.

Consider a simple political economy framework in which temperature shocks lower agricultural output and incomes and hence cause political unrest. This unrest can be driven by either peasants or elites. Low incomes can cause peasants to rebel directly. But low agricultural output could also cause a crisis of 'surplus extraction' among elites (as low agricultural output reduces the amount of income they can extract via rents, taxes or feudal dues). In these situations, Jews were often targets – either because they were held to be directly responsible for the misfortune of the population or because they were vulnerable targets and perceived to possess large amounts of wealth. As a result, this framework predicts that periods of colder temperature will be associated with a higher probability of persecution.

Rulers of states with high state capacity can quell such rebellions relatively easily. In contrast, rulers of states with low capacity are highly vulnerable to either popular or elite unrest. Stronger rulers will therefore be able to credibly commit to protecting their Jewish community regardless of the income shocks that they face. Weaker rulers, however, will not be able to make such a commitment. Moreover, rulers of states with less developed fiscal capacity will be more likely to face a fiscal crisis as a result of periods of sustained low harvests, whereas rulers of states with greater fiscal capacity will have more access to alternative sources of revenue and revenue-smoothing technologies. For states with low fiscal capacity, on the other hand, the easily appropriable wealth of the Jewish community will be a more tempting target in periods of fiscal distress. As a result, weaker rulers are more likely to expropriate Jewish communities themselves, in anticipation of antisemitic violence or unrest.

[13] In general, there is an optimal temperature, say T^*, that solves: $Q = F(T; \mathbf{X})$ where Q is agricultural output and $\mathbf{X}$ a vector of other inputs. Deviations from the optimal temperature $|T - T^*|$ lower agricultural output. A temperature shock is a deviation that is large relative to the standard deviation of temperature fluctuations.

[14] Numerous studies argue that there is a strong relationship between cold temperature and reduced agricultural output in western Europe (see Galloway, 1986, for a survey of this literature). According to Porter and Gawith (1998) wheat has a lethal low temperature of $-17.2 \pm 1.2^\circ C$, and a lethal high temperature of $47.5^\circ C$. They note that the optimal temperature for wheat cultivation over the course of the growing season is between 17 and $23^\circ C$ (Porter and Gawith, 1998, p. 25).

A second prediction from this analysis is that the relationship between colder temperatures and Jewish persecution will be stronger in areas governed by weak states.

Finally, our framework suggests several other factors that could mediate the relationship between temperature shocks and persecutions. There is evidence that regions with poorer quality soil might be more vulnerable to periods of colder temperature as better soil quality mitigates the negative effect of a temperature shock.[15] However, areas with poorer quality soil might also have higher demand for the lending services provided by Jewish communities. Therefore, rulers might have a stronger incentive to protect Jewish communities in these regions. *A priori* it is unclear which effect would dominate. Second, market integration and access to urban markets could dampen the effect of local temperature shocks on agricultural outcome and food price. It should be noted, however, that there were limits to the ability of markets to smooth shocks to output in the pre-industrial world as it was expensive to transport foodstuffs.[16] Moreover, spatial correlation in temperature shocks limited the ability of markets and trade to smooth volatility in the price of food staples. Nevertheless, in areas closer to well-developed markets, we expect the relationship between cold temperatures and persecutions to be weaker.

3. Empirical Analysis: The Effect of Temperature Shocks on Jewish Persecutions

Our main empirical specification is as follows:

$$y_{it} = \beta T_{i,t-1} + \eta_i + \mu_t + \mathbf{X_{it}\Omega} + \varepsilon_{it}, \tag{1}$$

where y_{it} is a binary variable measuring whether a persecution or expulsion occurred in city i during period t. When we include all violent acts against Jews in the dependent variable we call this measure *Persecutions*. When we only include expulsions, this variable is labelled *Expulsions*. $T_{i,t-1}$ is a measure of the average temperature for city i in the period preceding the persecution expressed as the degrees celsius deviation from the 1961–90 average. We report both estimates in which we include a full vector of city fixed effects, η_i, as well as the DID estimates, which include time dummies, μ_t. In our baseline regressions, we use five-year averaged data so that each period t refers to an average of temperatures over the years in that period e.g. 1535–9; consequently we have 140 observations for each city.[17] We do this primarily because of the potential

[15] There are several reasons why we expect regions with poor quality soil to be more vulnerable to climatic shocks. Higher quality soil is more robust to extreme variations in temperature (Porter and Semenov, 2005). Consistent with this, Malik and Temple (2009) find that regions with poor soil quality appear to experience greater volatility in agricultural output. In this case, a population in an area with poor soil quality might be more vulnerable to colder temperatures than a population in an area with high quality soil, even if their levels of *per capita* income were similar.

[16] Masschaele provides estimates of transport costs for fourteenth century England. On average, transporting wheat by land would increase the price by 0.4% per mile – doubling the price of grain for every 250 miles travelled. A ten mile journey raised the price by 4% (Masschaele, 1993, p. 274). Other evidence suggests that transporting grain was much more expensive in most of continental Europe.

[17] That is, seven centuries of data times twenty five-year periods in each century.

measurement error in both the persecutions data and the temperature variable (Guiot and Corona, 2010).[18] As such, if the persecution is recorded as occurring in 1541, we use the data on temperature from 1535 to 1539 to explain it in the five-year data. We focus on temperature during the preceding five-year period rather than temperature during the contemporaneous period in order to reduce measurement error and because historians argue that successive bad harvests placed the greatest strain on agricultural societies.[19] In Section 4, we show our results are robust to using yearly data with city fixed effects and year dummies.[20] All regressions include controls for the ten years surrounding the Black Death in Europe (1346–55) and a measure of urban density around city i at time t.[21] We use a linear probability model as our main specification. We prefer the linear probability model as nonlinear models with fixed effects suffer from the incidental parameter problem and this can bias asymptotic standard errors downwards (Greene, 2004).

3.1. *Data*

In order to measure violence against Jews, we use city–level data on the presence of a Jewish community in Europe between 1100 and 1800 taken from the Encyclopedia Judaica (2007). There are 1,069 cities in our complete data set. This number falls to 936 after we introduce our urban density control variable.[22] Figure 1 illustrates the geographic coverage of our Jewish city data and the distribution of persecutions for the entire period. The *Encyclopedia* typically mentions when Jews entered a city, when they were expelled, when there was some other violent act perpetrated against them, and when they were allowed re-entry (if ever). We are interested in all of these pieces of information since in order to model the probability of violence against Jews, we need to know when that city had a Jewish population.[23]

Using these data, we construct a variable called 'Jewish Presence,' which is equal to one during all the years there is a known Jewish community in the city and zero otherwise. There is a Jewish community present in the average city about 40% of the time. Our dependent variable *Persecution* is binary and measures whether there is either an expulsion or any other major violent act (i.e. a pogrom) against Jews in a city in a given five-year period. There are 1,366 such events in our base data set: 821 expulsions and 545 pogroms. Our other dependent variable is *Expulsion* and

[18] For instance, several medieval edicts of expulsion allowed the Jews a period of time of up to six months to leave the city. Thus, for several cities, different sources record different dates of expulsion for a single event e.g. the city of Cologne decided not to renew the permit it granted Jews to reside in the cities in 1423, but only enforced the expulsions of the Jewish community itself in 1424.

[19] These claims are robustly supported by our placebo regressions which we report in Section 4. There we find effects of negative temperature on persecution probability up to eight years preceding the event. Reassuringly, we find no evidence that future temperature affects persecution probability.

[20] In the yearly regressions, e.g. the persecution in 1541 is explained using temperature data in the five-year period prior to the persecution i.e. 1537 to 1541.

[21] See online Appendix D for a discussion of the Black Death and violence against Jews. See online Appendix C for further description of the population density measure.

[22] We lose some cities in eastern Europe. Excluding the urban density control and including these cities did not change results.

[23] A more detailed description of all our data is contained in online Appendix C.

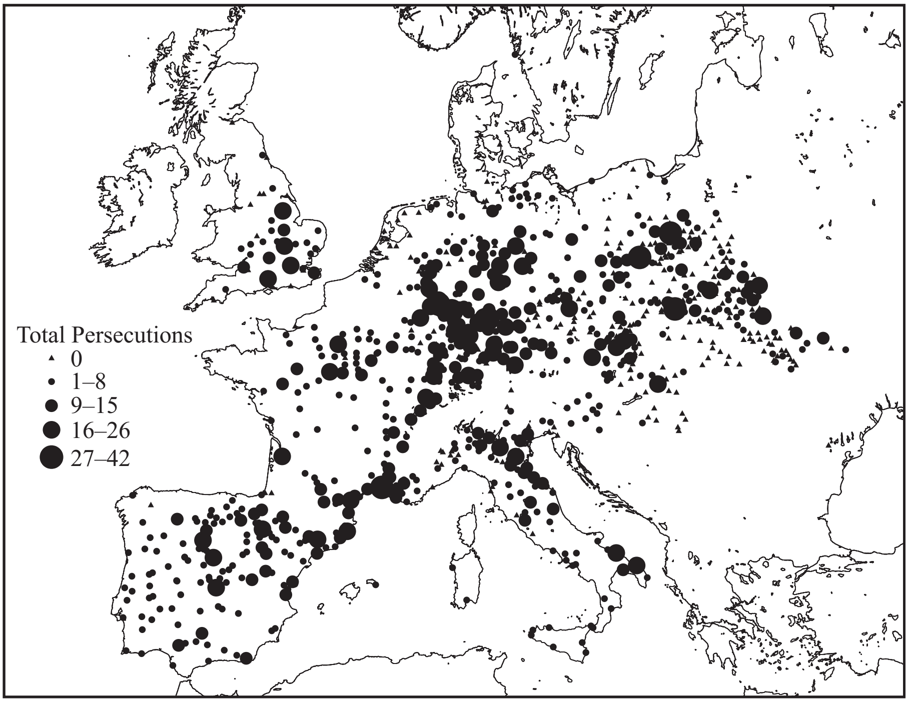


Fig. 1. *Jewish Persecutions, 1100–800*
Notes. Circles represent a Jewish city that has at least one persecution. Larger circles represent more persecutions. Triangles are Jewish cities in our data that never persecuted.
Source. Encyclopedia Judaica (2007).

measures whether there is an expulsion or not in the city during the five-year period.

We restrict our analysis to use only the sample of cities that currently have a Jewish population. Cities without a Jewish population are treated as missing variables. This approach is consistent with a conventional strategy used in discrete-time survival analysis as discussed by Box-Steffensmeier and Jones (2004) and Yamaguchi (1991). Furthermore, our results will also be easier to interpret than with the alternative Cox hazard models.

In order to measure temperature shocks, we employ data on reconstructed temperature for medieval and early modern Europe provided by Guiot and Corona (2010). Guiot and Corona (2010) collect information from numerous proxy sources including 95 tree ring series, 16 indexed climatic series based on historical documents, ice-core isotopic series, and pollen-based series to construct a 32 point grid of reconstructed temperature during the growing season (April to September) for all of Europe between 900 and the present day. Their historical temperature reconstructions are based on model mapping proxies into growing season temperatures. This model is calibrated using actual temperature data from 1850 to 2007. We use geospatial software to interpolate the temperature for the area between the grid points so that we have a smooth map for each year. Finally, we extract the yearly temperatures for each of our cities. We follow Guiot and Corona (2010) in expressing the temperature data in terms of differences relative to the 1961–90 average.

To address potential bias stemming from unobserved economic development of a city or its access to markets, we construct a measure of urban density. This approach is consistent with other work on early modern Europe that relies on urbanisation data in lieu of estimates of *per capita* GDP or market development.[24] Our urban density variable is called *PopDensity* and is based on the Bosker *et al.* (2013) dataset of cities. As our Jewish cities do not correspond perfectly to the Bosker *et al.* cities, we use geospatial software to create a population heat map for every century based on all Bosker *et al.* cities with populations greater than 5,000. Each point on the map is assigned a population number based on the inverse distance-weighted value of all Bosker *et al.* cities within 1 degree of the point (about 100 kilometres depending on the latitude).[25]

One other potential source of bias in our estimates is the disproportionate effect of the Black Death on Jewish persecutions in the years immediately following its arrival in Europe in 1348. Figure 2 shows how average temperature and the total number of persecutions varied over time. The Black Death is an obvious outlier.[26] Jewish communities faced unprecedented levels of persecution during the first wave of the plague – as they were singled out as scapegoats and easy targets of expropriation and popular violence as the existing social order weakened (Voigtländer and Voth, 2012). Since we do not want to identify the effect of temperature on antisemitic violence using a disproportionate number of observations associated with epidemiological causes, we choose to control for the Black Death years by allowing both the intercept and the slope in all specifications to vary for the years 1346–55.

3.2. *Baseline Results*

In panel (*a*) of Table 1, we report the results of estimating (1) using *Persecution* as the dependent variable in columns (1)–(3) and *Expulsion* as the dependent variable in columns (4)–(6). Robust standard errors clustered on the nearest temperature grid point from Guiot and Corona (2010) are reported in parentheses.[27] We multiply all coefficients by 100 for ease of interpretation.

In specification (1), we report the β under OLS regression with controls included but with no fixed effects. The negative sign implies that colder temperature raises the probability of a persecution of Jewish communities. The size of the coefficient implies a one degree decrease in five-year average temperature leads to a 1.91 percentage point

[24] See De Long and Shleifer (1993); Acemoglu *et al.* (2005) and Nunn and Qian (2011) among many others.

[25] We provide more details about the construction of this and other variables in online Appendix C and descriptive statistics are in online Appendix A.

[26] Another potentially influential set of data points are associated with the Iberian national expulsions at the end of the fifteenth century. We will exclude these from our regressions in panel (*b*) of Table 1 to demonstrate the robustness of our baseline results.

[27] These grid points are reproduced as the red dots in online Appendix C, Figure C6. Cities closer to a given grid point receive more correlated temperature shocks. In contrast, temperature shocks are a random walk over time, thus the temperature-grid seems the appropriate level of clustering.

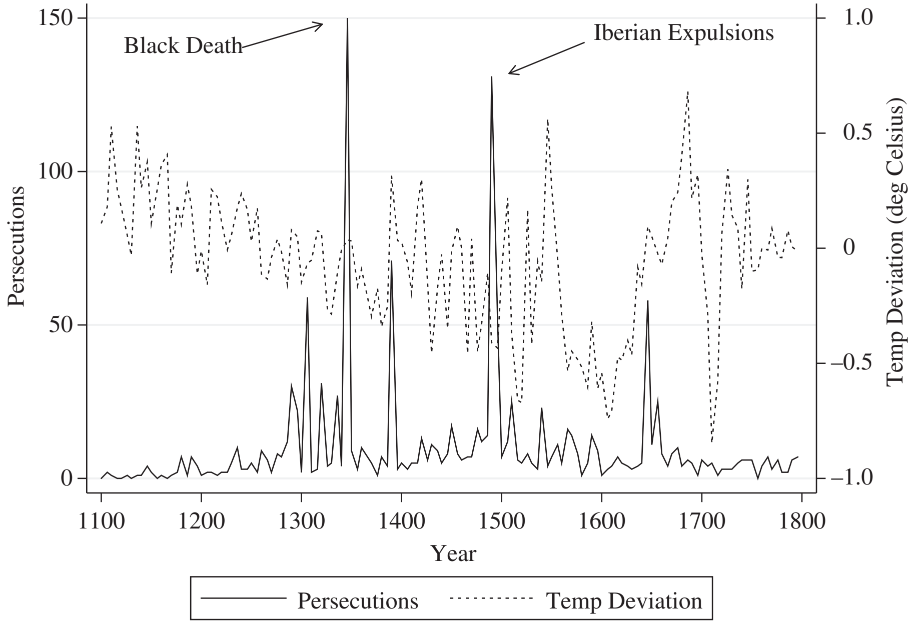


Fig. 2. *Jewish Persecutions and Temperature Deviations*
Source. Encyclopedia Judaica (2007) and Guiot and Corona (2010).

increase in the probability of a major act of violence against Jews over the subsequent five years. When we include city fixed effects in specification (2), this probability increases to 2.52 percentage points. Including five-year time dummies in specification (3) increases the DID estimate to 3.19 percentage points.

Although a one degree decrease in temperature is convenient to consider, it is also quite large. Under the DID specification in column (3), a one standard deviation decrease, or 1/3 of a degree, in temperature increases five-year persecution probability by 1 percentage points which is equal to 50% of the sample mean of the dependent variable (2.22). Restricting our attention to explaining just expulsions in columns (4)–(6) of panel (*a*) of Table 1 yields similar results.

Panel (*b*) of Table 1 replicates the results in panel (*a*), after excluding the Iberian national expulsions. In general, the sizes of the coefficients we obtain are smaller but they retain statistical significance. Our preferred DID estimator suggests that a one degree decrease in the temperature of the previous five years is associated with a 1.6 percentage points increase in the probability of persecution. A one standard deviation decrease in temperature increases the probability of persecution by a half a percentage point (0.34×1.6). Overall, our main results are robust to the exclusion of the Iberian expulsions.

The results in Table 1 provide strong empirical support for the first prediction of our model: colder temperature disrupted the political equilibria of pre-industrial European societies and increased the likelihood that minority communities would be persecuted. However, on their own, these regressions do not shed light on the

Table 1

Baseline Results

	Persecutions			Expulsions		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel (a): Baseline effects of temperature on persecutions and expulsions						
$Temperature_{i,t-1}$	−1.91***	−2.52***	−3.19***	−1.59***	−2.06***	−2.31***
	(0.625)	(0.740)	(1.04)	(0.447)	(0.512)	(0.891)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
City dummies	No	Yes	Yes	No	Yes	Yo
Time dummies	No	No	Yes	No	No	Yes
N	55,698	55,698	55,698	55,698	55,698	55,698
F	5.202	5.609	6.695	4.741	5.705	5.108
p-values	0.0029	0.0019	0.0006	0.0048	0.0017	0.0012
Panel (b): Excluding the Iberian national expulsion						
$Temperature_{i,t-1}$	−1.08***	−1.57***	−1.60***	−0.751***	−1.10***	−0.667*
	(0.259)	(0.382)	(0.527)	(0.132)	(0.232)	(0.380)
No Iberian National	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
City dummies	No	Yes	Yes	No	Yes	Yes
Time dummies	No	No	Yes	No	No	Yes
N	55,253	55,253	55,253	55,253	55,253	55,253
F	6.759	6.604	6.214	9.128	6.837	3.566
p-values	0.0006	0.0007	0.0012	0.0001	0.0006	0.0284

Notes. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors clustered at the climate gridlevel *n* parentheses. Co-efficients are multiplied by 100 to represent percentage points. Observations are at the city × five-year level between 1100 and 1799. In both panels the dependent variable is either *Persecution* (0 or 1 if either an expulsion or other violent acts against Jews occurs) or *Expulsion*. Panel (a) uses the full sample. In panel (b) the Iberian national expulsions in 1492 (Spain) and 1497 (Portugal) are excluded. All regressions include as controls a dummy and slope variable for the 10 years surrounding the Black Death and a measure of population density (see online Appendix C). Co-efficients are reported with standard errors clustered at the temperature-grid level.

economic, institutional and political mechanisms connecting negative temperature shocks to Jewish persecutions.

3.3. *Mechanisms*

Our conceptual framework suggests that the effect of temperature shocks on Jewish persecutions should be greatest in societies with weak political institutions. It also provides some reason for expecting differential results in areas with poorer quality soil. Areas with worse quality soil might be more vulnerable to temperature shocks. But the value of Jewish moneylending to a ruler might also be more valuable in such regions. In this subsection, we explore these predictions by estimating a series of specifications based on:

$$y_{it} = \alpha T_{i,t-1} + \beta M_{it} + \zeta M_{it} \times T_{i,t-1} + \eta_i + \mu_t + X_{it}^{\prime}\Omega + \varepsilon_{it}, \quad (2)$$

where y_{it} is our measure of persecution or expulsion in city i in period t. $M_{i,t}$ is one of our mechanisms, such as a measure of soil suitability or state capacity for city i in period

t. For consistency and ease of interpretation, we code the mechanism variable to be either a 0 or 1 such that 1 corresponds to our theoretically predicted higher probability of a persecution (e.g. poor soil or low state capacity).[28] $M_{i,t} \times T_{i,t-1}$ is an interaction variable of the mechanism with the lagged temperature shock. η_i and μ_t are city and time dummies respectively, $\boldsymbol{X}_{it}$ is a vector of control variables, and ε_{it} is an i.i.d. error term. We are interested in three quantities: the effect of temperature on persecution probability in cities where the mechanism is not present, α; the indirect effect of the mechanism on persecution probability, ζ; and the total effect of temperature on persecution probability in cities where the mechanism binds, which is given as, $\partial y_{i,t}/\partial T_{i,t-1} = \alpha + \zeta \times M_{i,t}$, with $M_{i,t}$ evaluated at 1.

The first mechanism we investigate in Table 2 is whether cities surrounded by low quality soil were more likely to persecute their Jewish communities. In columns (1) and (2), we test this hypothesis using our preferred measure of agricultural productivity – wheat suitability taken from the FAO (Fischer *et al.*, 2002). This database is constructed by combining characteristics of wheat (optimal growing temperature, soil type etc.) with highly disaggregated climatic and geographic data covering variables such as precipitation, cloud cover, ground-frost frequency, soil types and slope characteristics. The data have a spatial resolution of 0.5 degree × 0.5 degree (or about 60 × 60 kilometres at 45 degrees latitude, typical for France).[29] We extract the wheat suitability for each of our cities using geospatial software and then follow a similar strategy as Nunn and Qian (2011) in creating a dummy variable equal to one if a city has an agricultural sector that is either moderately or significantly constrained in its wheat cultivation. This is the main variable *Low Wheat* that we use in our regressions.

Regressions (1) and (2) show that cities with soil unsuited for agriculture were more likely to persecute Jews. In the fixed effects regression in column (1), the coefficient on ζ is 2.77 and statistically significant.[30] This accounts for more than half of the overall effect of temperature on persecutions reported at the bottom of the column as 3.98. Under the DID specification in column (2), the coefficients on the indirect effect of temperature through soil suitability is not statistically significant. Nonetheless, the overall effect is precisely estimated and economically significant with a value of 3.66.[31]

We next test whether persecutions were more likely in cities associated with comparatively weak polities. To do this, we employ the disaggregated data from the State Antiquity Index of Bockstette *et al.* (2002). These data include a measure for modern-day countries of whether that area was a stable state for 50-year intervals from 1 B.C. to the present day. Specifically, every modern-day country, in each 50-year period, is assigned three numbers. The first is a one if there was a government above tribal level and a zero otherwise. The second number is a one if the government is locally based, 0.50 if it is foreign based, and 0.75 if in between. The third number measures how

[28] In online Appendix B Table B1, we provide results using continuous measures of both soil quality and state antiquity.

[29] We assume 'intermediate' inputs. Online Appendix C describes these data in more detail.

[30] The direct effect of *Low Wheat* is not reported since it is a time-invariant variable and thus absorbed by the fixed effects.

[31] We also run our mechanism regressions for soil quality using continuous versions of these variables in online Appendix B. The results for soil quality clearly show a statistically significant effect for low quality soil and zero effect for high quality soil.

Table 2

Mechanisms

	Dependent variable: persecutions							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Temperature$_{i,t-1}$	−1.21**	−2.53***	−1.38***	−2.20***	−2.75**	−3.59***	−3.03**	−3.30**
	(0.485)	(0.876)	(0.429)	(0.738)	(1.01)	(1.24)	(1.36)	(1.64)
Low wheat × *Temperature*$_{i,t-1}$	−2.77**	−1.13						
	(1.29)	(0.731)						
Low State Antiquity			0.760	2.09***				
			(0.454)	(0.524)				
Low State Antiquity × *Temperature*$_{i,t-1}$			−2.92**	−2.34***				
			(1.18)	(0.78)				
Low Constraints					−1.43**	0.321		
					(0.611)	(0.699)		
Low Constraints × *Temperature*$_{i,t-1}$					1.29	1.36*		
					(1.02)	(0.758)		
Low Capital Protection							−1.63*	0.259
							(0.89)	(0.626)
Low Capital Protection × *Temperature*$_{i,t-1}$							0.876	0.113
							(1.26)	(1.04)
Temperature$_{i,t-1}$ + *Interaction*	−3.98***	−3.66***	−4.30***	−4.54***	−1.46***	−2.23***	−2.16***	−3.19***
	(1.2)	(1.2)	(1.20)	(1.26)	(0.37)	(0.69)	(0.6)	(0.83)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	No	Yes	No	Yes	No	Yes	No	Yes
N	55,698	55,698	55,698	55,698	55,698	55,698	55,698	55,698
F	6.857	15.65	5.891	6.254	11.36	4.275	4.351	5.664
p-values	0.0003	0.0000	0.0000	0.0005	0.0000	0.0052	0.0032	0.0010

Notes. *p < 0.10, **p < 0.05, ***p < 0.01. Standard errors clustered at the climate grid level *n* parentheses. Observations are at the city × five-year level between 1100 and 1799. The dependent variable is *Persecution* (0 or 1 if either an expulsion or other violent acts against Jews occurs). All Mechanism variables are 0 or 1. See text and online Appendix C for descriptions of the Mechanism variables. All regressions include as controls a dummy and slope variable for the 10 years surrounding the Black Death and a measure of population density. *Temperature* + *Interaction* is the total effect of temperature on persecution probability measured as the sum of the coefficient of *Temperature* plus that of the relevant Mechanism interaction term. Coefficients are reported with standard errors clustered at the temperature-grid level.

much of the territory of the modern government was ruled by the polity during the 50-year period.[32] These scores are then multiplied by each other and then by 50. This results in a panel of scores for present day countries measuring in every 50-year period whether it was an autonomous nation (a score of 50) if it had a tribal level of government (score of 0) or something in between. Bockstette *et al.* (2002) then aggregate these data to get a single score for state antiquity of modern countries. We are interested in the disaggregated historical data, however. Thus, after interpolating between 50-year periods, we extract their values for each of our cities using geospatial software. We then create a dummy variable for each city equal to one if that region has a score less than the average for the rest of the sample and zero otherwise. We call this dummy *Low State Antiquity*.[33]

The regression results in columns (3) and (4) of Table 2 support our theoretical prediction that cities in regions with weaker states will be more likely to persecute Jewish populations. The coefficient on the indirect effect of *Low State Antiquity* are negative and statistical significant in both the FE and the DID specifications. Furthermore, when compared to the total effects reported at the bottom of the Table, the estimates suggest that being in a low state capacity region accounts for something on the order of half of the increased probability of persecution due to negative temperature shocks. The estimated effect size of 2.34 in the DID specification suggests in states with low antiquity the effect of cold temperature on the probability of a persecution was approximately twice as high as in the baseline. The coefficients on the direct effect of *Low State Antiquity* are positive, which suggests that regardless of temperature, Jewish communities in low state capacity regions were more likely to be persecuted.

Our conceptual framework suggests that it was strong and stable states, not necessarily states with constraints on the executive or rules protecting capital that were more likely to be able to commit to rent-seeking arrangements with Jewish communities in the medieval and early modern period. Therefore, we want to disentangle the effect of state capacity from the effects of constraints on the executive or protection of property rights.

To do this, columns (5)–(8) of Table 2 test whether the Acemoglu *et al.* (2005) measures of constraint on executive and protection of capital predict persecutions. We re-code their constraints variables so as to be comparable to our *Low State Antiquity* variable by turning them into dummy variables where countries with constraints below the sample average get a one and high constraint countries are zeroes. We then interpolate these values between centuries and extract their values for each city (descriptive statistics are in online Appendix A). We measure (lack of) constraints on the executive using *Low Constraints*. The variable measuring (lack of) protection of capital is *Low Capital Protection*.

The regression results showing the effect of *Low Constraints* on persecution probability are in columns (5) and (6). The fixed effects specification indicates that cities located in regions with less constraint were less likely to persecute Jews. The

[32] The values for this last measure are 1 point if over 50%, 0.75 points if between 25% and 50%, 0.5 points if between 10% and 25%, 0.3 points if less than 10%.

[33] Descriptive statistics are in online Appendix A. As a robustness check, we also code our state antiquity variable as a continuous variable. We report these regressions in online Appendix B.

interaction of *Low Constraints* with $Temperature_{i,t-1}$ is statistically insignificant. Under the DID specification, the level of the *Low Constraints* variable has the wrong sign.

When we look at our measure of capital protection in columns (7) and (8), the results are similar. The sign on the direct effect of *Low Capital Production* is negative in our fixed effects specification indicating that less constraint in an area is associated with less persecution. The sign on the interaction is positive though insignificant. Under the DID specification in column (8), the coefficient on *Low Capital Protection* is consistent with zero. Overall, these regressions support our argument that it was state capacity that determined whether a Jewish community would be persecuted during times of economic crisis.

The empirical findings we report in Table 2 provide evidence in support of our hypothesis that the effects of colder weather would be greater in weak states. They also provide some albeit less robust evidence that the effects of colder weather were greater in areas with lower quality soil. There is no evidence that constraints on the executive and protection of capital were associated with protection of minorities in the medieval or early modern period. As we discuss below, these results are consistent with a body of historical research that suggests that while, in the long-run, state capacity and constraints on the executive are complements (Besley and Persson, 2011), in the medium-run, investments in state capacity often preceded the imposition of constraints on the executive (Dincecco, 2009; Johnson and Koyama, 2014*a*). In the next Section, we investigate the robustness of these results.

4. Robustness

4.1. *Results with Yearly Data*

In the previous Section, our empirical results were all based on five-year periods. In this Section, we explore how robust our results are to using yearly data.

Table 3 shows the results from estimating 1 using yearly data. Our main variable of interest is the average temperature for the years t_{-1} to t_{-5}.[34] To maintain symmetry with the analysis above, in the Tables we refer to this variable as $Temperature_{i,t-1}$. In column (1), we report the specification with city fixed effects. Our coefficient of interest is negative, and implies that a series of one degree colder growing seasons are associated with a 0.46 percentage points higher probability of persecution. The DID specification in column (2) is smaller than the FE coefficient and less precisely estimated (p-value = 0.174).[35]

Table 4 reports the results from estimating 2 testing the effect of our hypothesised mechanisms using the yearly data. Wheat suitability does not have a precisely estimated effect on persecution probability when we employ yearly data (cols. 1–2). However, the

[34] If the persecution is in 1541, for example, then we use temperature data in the five-year period of 1536 to 1540 to explain it.

[35] The coefficients using the one-year data are typically about a fifth of those using the five-year average data, though the interpretation of the effect size is similar. A typical coefficient from the five-year DID regressions is −1.25. This means a one degree decrease in temperature during the previous five years leads to a 1.25% increase in persecution probability over the next five years (or about 0.25% each year). The coefficient of −0.272 in Column 3 of revised Table 3 means a 1 degree decrease in temperature during the previous five years leads to about a quarter of a percentage increase in persecution probability in just the next year (as opposed the next five years).

Table 3
Baseline Results Yearly Data

Baseline effects of temperature on persecutions and expulsions						
	Persecutions			Expulsions		
	(1)	(2)	(3)	(4)	(5)	(6)
$Temperature_{i,t-1}$	−0.346***	−0.464***	−0.272	−0.272***	−0.360***	−0.150
	(0.104)	(0.124)	(0.174)	(0.075)	(0.0837)	(0.130)
Controls	Y	Y	Y	Y	Y	Y
City dummies	N	Y	Y	N	Y	Y
Time dummies	N	N	Y	N	N	Y
N	276,359	276,359	276,359	276,359	276,359	276,359
F	4.682	5.726	2.444	4.758	6.148	1.340
p-values	0.005	0.002	0.129	0.005	0.001	0.256

Notes. *p < 0.10, **p < 0.05, ***p < 0.01. Standard errors clustered at the climate grid level in parentheses. Observations are at the city × one-year level between 1100 and 1799. Otherwise controls are the same as those employed in Table 1.

overall effect of wheat suitability and temperature remains large. Our measure of state antiquity remains robust. Our largest estimate for the effect of weather on persecutions is in the FE regression in column (3).

4.2. *The Iberian Expulsions*

One potential objection to our results is that the expulsions of Jews from Spain in 1492 and Portugal in 1497 represent a large proportion of the variation in the outcome. The traditional explanations for the timing of the Spanish expulsions of 1492 is that Ferdinand and Isabella were driven by nationalist and religious motives and that the timing of the expulsions simply followed from the unification of Spain following the conquest of Granada.[36] Revisionist accounts also emphasise the importance of local elites in demanding the expulsion in return for supporting the monarchy (Haliczer, 1973). When we exclude the Iberian expulsions the size of our coefficients shrink by roughly a half. A one standard deviation decrease in temperature now increases the baseline probability from 2% to 2.5%. Therefore in qualitative terms our results are robust to exclusion of the Iberian expulsions.

4.3. *Placebo Regressions*

An assumption of our identification strategy is that the temperature data are random and, thus, unrelated to unobservables that could potentially lead to bias in our estimates. We perform a placebo test in order to test this assumption.

We re-estimate 1 replacing the value for a city's current temperature with those from previous years and for future years. Figure 3 depicts the coefficients that we obtain from this regression using yearly data. It demonstrates that the coefficient on

[36] For studies of the expulsion of Jews from Spain see Kamen (1988), Gerber (1992), Roth (1995).

Table 4

Yearly Mechanism Regressions

	Dependent variable: persecutions							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Temperature$_{i,t-1}$	−0.292**	−0.168	−0.276**	−0.156	−0.479***	−0.284	−0.577***	−0.278
	(0.114)	(0.168)	(0.310)	(0.687)	(0.657)	(1.343)	(0.728)	(1.064)
Low Wheat × *Temperature*$_{i,t-1}$	−0.432*	−0.212						
	(0.227)	(0.136)						
Low State Antiquity			0.174*	0.481***				
			(0.395)	(0.455)				
Low State Antiquity × *Temperature*$_{i,t-1}$			−0.485**	−0.269				
			(0.868)	(0.554)				
Low Constraints					−0.300**	−0.284		
					(0.130)	(0.200)		
Low Constraints × *Lag Temperature*$_{i,t-1}$					0.171	0.045		
					(0.201)	(0.156)		
Low Capital Protection							−0.378*	−0.010
							(0.214)	(0.549)
Low Capital Protection × *Temperature*$_{i,t-1}$							0.190	0.010
							(0.178)	(0.205)
Temperature$_{,t-1}$ + *Interaction*	−0.724***	−0.380*	−0.761***	−0.426*	−0.308***	−0.240	−0.387***	−0.268*
	(0.210)	(0.211)	(0.202)	(0.213)	(0.096)	(0.150)	(0.107)	(0.150)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	No	Yes	No	Yes	No	Yes	No	Yes
N	276,359	276,359	276,359	276,359	276,359	276,359	276,359	276,359
F	9.988	1.797	4.945	8.611	9.240	0.945	4.616	1.087
p-values	0.000	0.184	0.002	0.001	0.000	0.432	0.002	0.371

Notes. *p < 0.10, **p < 0.05, ***p < 0.01. Standard errors clustered at the climate grid level *n* parentheses. Observations are at the city × one-year level between 1100 and 1799. All controls and variable details are otherwise the same as in Table 2.

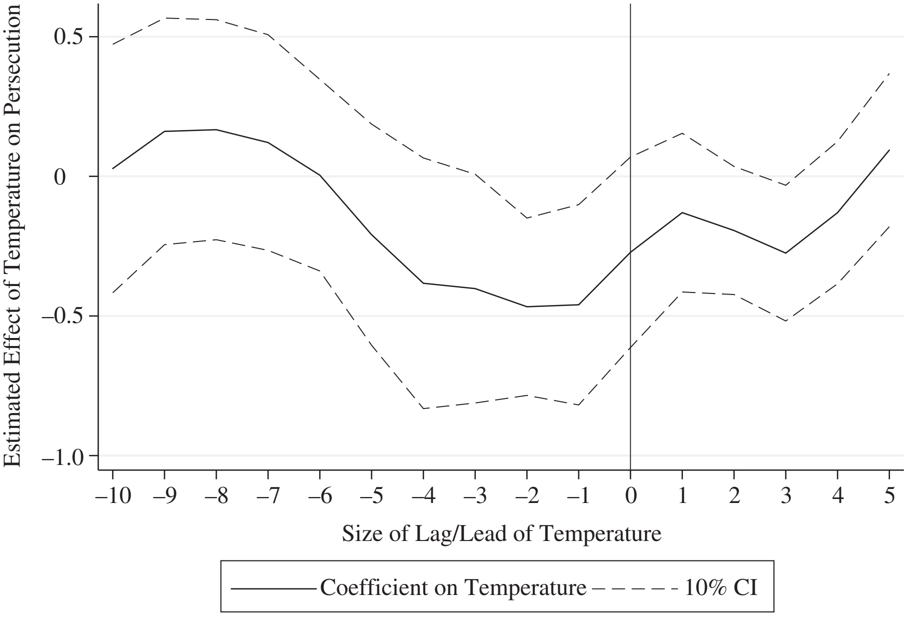


Fig. 3. *Placebo Regressions Using One-year Data*
Notes. Dotted lines are 10% confidence intervals. Vertical line marks $t = 0$.

temperature is significant and fairly large up to about 5 lags thereby justifying our use of $\text{Temperature}_{i,t-1}$ as our main explanatory variable. Importantly, it shows that the effects of future temperature are indistinguishable from zero.

4.4. *Spatial and Serial Correlation*

Temperature is highly spatially correlated. To ensure that our results are not biased due to spatial spillovers, in Table B2 in online Appendix B, we replicate our baseline and mechanism regressions controlling for spatial and serial correlation using the method suggested by Conley (2008) and implemented in Stata code by Hsiang (2010). These results corroborate our main analysis.

4.5 *Rainfall and Persecution*

As a check on the robustness of our claim that supply shocks caused Jewish persecution, we also compile data on rainfall between 1500 and 1799 to re-estimate our main regressions. For dry soil farming, wheat requires at least 60 cm of annual rainfall. Higher levels of rainfall are particularly important for increasing yields during the growing season as the the demand for water increases with leaf growth which peaks between July and August.[37] Estimates for historical levels of rainfall at a disaggregated

[37] Abnormally low summer temperatures are often associated with excess rainfall and this combination would be expected to lower yields. In general, however, too little rainfall was much more likely to reduce agricultural output.

level only exist from 1500 onwards therefore we do not include these data in our main regressions. In online Appendix B, Tables B3 and B4, we report both our baseline and mechanism regressions for the period 1500–1799 using data from Pauling *et al.* (2006). Table B3 provides evidence that too little rainfall during the growing season resulted in a higher probability of persecution. The OLS regression in Column 1 suggests a 10% decrease in rainfall raises the probability of a persecution in the subsequent five-year period by 2%.[38] In Column (3) where we report the OLS effect with an interaction for the period before 1600, the overall effect increases such that a 10% decrease in rain raises persecution probability by 5.8% Under the DID specifications in Columns (2) and (4), the effect of decreased rain is still present, though statistically insignificant. However, when we allow the city fixed effects to be different before and after 1600, then effect is again robustly negative with a 10% reduction in rain leading to a 7% increase in persecution probability. Overall, the rainfall regressions support our main finding that negative supply shocks induced Jewish persecutions in the early-modern period. The fact that the rainfall data are generated from a completely different source from the temperature series, we use and we can show effects even though there are only 100 years of data during the period, we believe supply shocks mattered most for Jewish communities (pre-1600) is encouraging support for our hypothesis.

Overall, our findings identify two forces that appear to have played a significant role in persecution probability. First, temperature shocks appear to have had greater effect in locales with relatively unproductive agriculture. Second, Jewish communities located in relatively weak polities were more likely to be persecuted during colder periods. This provides evidence in favour of our argument that in the face of negative economic shocks, weak rulers were less able to uphold the extractive rent-seeking arrangements that protected Jewish communities. In the next Section, we discuss additional evidence supportive of this explanation as well as assessing other hypotheses that may explain why Jewish persecutions declined during the later early-modern period.

5. Discussion: The Decline of Jewish Persecutions

We have documented a robust relationship between periods of colder temperature and Jewish persecutions. After around 1600, however, the relationship between colder temperature and the likelihood of persecution disappeared. This can be seen in Figure 4 which depicts the coefficients from our baseline regression (Table 1) estimated by century (the 12th century is the excluded category).[39]

[38] The rainfall variable is constructed in a similar manner to the temperature variable in our baseline five-year regressions. The only difference is that we express it in logs.

[39] We estimate the following regression:

$$y_{it} = \sum_{c=13th}^{18th} \beta_c T_{i,t-1it} \times \mathbf{I}_c + \eta_i + \mu_t + \mathbf{X}'_{\mathbf{it}}\boldsymbol{\Omega} + \varepsilon_{\mathbf{it}}, \tag{3}$$

where $\mathbf{I_c}$ is a vector of dummies for each of the thirteenth to eighteenth centuries (the twelfth century is the excluded category). Standard errors are clustered at the climate grid level.

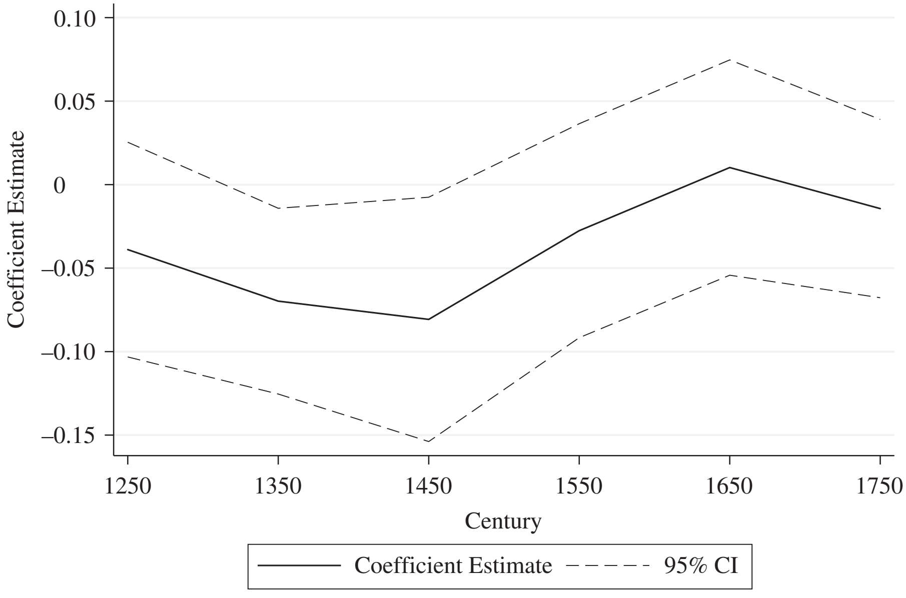


Fig. 4. *The Effect of Temperature on Persecution Probability Over Time*
Notes. Plots coefficients estimate by century of the baseline DID regression. Specification discussed in the text.

The data suggest that Jewish persecutions were particularly intense in late medieval and Renaissance Europe and often triggered by supply shocks. After 1600, however, colder temperatures ceased to be associated with a greater risk of persecution.

In this Section, we discuss in greater detail five possible reasons for the decline in Jewish persecutions:

(*i*) that there were simply fewer Jewish communities to persecute by the seventeenth century;
(*ii*) that improved agricultural productivity, or, better integrated markets could have reduced vulnerability to temperature shocks;
(*iii*) that the rise of stronger states could have led to more robust protection for religious and ethnic minorities;
(*iv*) that there were fewer negative temperature shocks; and
(*v*) that the impact of the Reformation and the Enlightenment may have reduced antisemitic attitudes.

5.1. *The Decline of Western and Central European Jewry?*

The change in the geographic distribution of Jewish communities after 1500 may partially account for the breakdown in the relationship between temperature shocks and Jewish persecutions. There was a definite move eastwards as Jewish communities,

Table 5
City-years Before and After 1600

Country	City-years before 1600	City-years after 1600	Persecutions before 1600	Persecutions after 1600	Persecutions per city year before/after 1600
Austria	4,223	1,402	19	7	0.90
England	3,530	1,414	55	0	∞
France	25,346	6,477	233	6	9.92
Germany	41,080	19,254	335	24	6.54
Italy	29,847	8,654	108	19	1.65
Poland	16,012	21,814	47	66	0.97
Portugal	5,734	0	21	0	∞
Spain	36,065	0	204	0	∞
Switzerland	2,890	697	25	2	3.02

Source. Encyclopedia Judaica (2007).

persecuted first in Germany and then later in Spain and Portugal, fled to either eastern Europe or the Ottoman Empire.[40]

The political equilibrium that governed the coexistence of Jews and Christians differed in eastern Europe. Whereas in western Europe, Jews specialised as moneylenders and came to be exploited as fiscal resources by medieval rulers, this did not occur to the same extent in medieval or early modern Poland. Historians note that the condition of the Jews in Poland was therefore relatively favourable compared to western Europe and remained so until the seventeenth century. Weinryb (1972, p. 51) notes that 'Jews themselves, both within the country and abroad, looked upon Polish Jews as living in security'. This reflected deeper institutional differences between Poland and the rest of Europe along a range of margins: Poland was also comparatively tolerant to heretics during the sixteenth century (Tazbir, 1973). One reason for this was that the economic underdevelopment of Poland meant that the possibilities for economic specialisation were also limited. As the division of labour was not as well defined, Jews continued to play a number of important economic roles in the Polish economy throughout the medieval and early modern period; they were not restricted to their role as moneylenders as was the case in western Europe after 1200 (Dubnow, 1975).[41] For this reason, it is likely that some of the migration to Poland may have been driven by its reputation as a relatively safe haven.

In Table 5, we calculate the number of city-years that a Jewish community was present in various countries in our data before and after 1600. In the case of Spain and Portugal, the reason they stopped persecuting Jewish communities after 1600 is because they did not have any openly acknowledged communities after the national expulsions of 1492 and 1497.[42] However, Spain and Portugal are extreme cases. The data in Table 5 show that, while there was definitely a movement of Jewish

[40] We do not discuss the Ottoman Empire, as the institutions governing the toleration of Jews in Ottoman territories were very different to those in Christian Europe.

[41] Consistent with this claim is the observation of Dubnow (1975) that there was antisemitic agitation in the cities of western Poland as conditions there were more hospitable to Jews in the more rural parts of central and eastern Poland.

[42] The Inquisition conducted intense persecutions of *conversos*. We discuss this issue in online Appendix C.

communities eastward towards countries such as Poland after 1600, there were still many Jews in most of the countries in our sample. Furthermore, the last column of Table 5 shows that, even if we express persecution probability in per city-year terms, there was a marked decline in Jewish persecution after 1600 for most countries.

5.2. *Greater Agricultural Productivity or Increased Market Integration*?

Another possible explanation for the reduction in the number of Jewish persecutions in western Europe and the breakdown in the relationship between temperature and persecutions is that an increase in agricultural productivity, or increased market integration, made European economies less vulnerable to supply shocks. This is certainly one of the explanations that our conceptual framework suggests. From the eighteenth century onwards, Malthusian conditions weakened and *per capita* incomes gradually increased. Nunn and Qian (2011), for example, document the role played by the potato in increasing population density and urbanisation after 1700. However, the frequency of Jewish persecutions markedly declined from around 1600 – a period when the European economy remained Malthusian and agricultural productivity was low.[43] Thus the Columbian Exchange occurred too late to explain the decline of Jewish persecutions.

Nevertheless, better market integration might be responsible for temperature shocks having a weaker impact on Jewish persecutions. To assess this, we use a panel of wheat prices from the Allen-Unger database.[44] This data set contains grain prices for 193 cities worldwide. We use wheat prices from the 98 European cities in this data set.[45] In Table 6, we run a series of regressions of *Temperature* on the log of wheat prices in the cities in this unbalanced panel. Columns (1) and (2) report our fixed effects and DID estimates using the entire panel. Because we expect a bad harvest due to colder temperature to raise grain prices in the same year, we focus on contemporaneous grain prices.

These regressions support our hypothesis that negative temperature shocks adversely affect grain markets. The coefficient on *Temperature* in specification (1) implies a one degree celsius decrease in temperature increases wheat prices by about 9%. This estimate is halved in the DID regression. In column (3), we include a lag of the dependent variable to account for potential serial correlation and the estimate shrinks further while retaining the negative sign and its significance.[46] Temperature shocks affected agricultural output as measured by grain prices.[47]

[43] Recent research finds evidence that the Malthusian equilibrium weakened in England during the seventeenth century; see, for instance, Crafts and Mills (2009). But the overwhelming consensus is that agricultural productivity remained low outside England and the Netherlands throughout the seventeenth century; see Allen (2000) amongst many others.

[44] The Allen-Unger Global Commodities database is available at http://www.gcpdb.info/.

[45] Figure C8 in online Appendix C shows their locations. Descriptive statistics are in online Appendix A.

[46] A Fisher-type unit root test on the data convincingly rejects the null of a unit root. This implies the inclusion of the lagged dependent variable term is unnecessary. Nonetheless, we include it as a cautionary measure.

[47] While these coefficients are small, they are also consistent with what we know about medieval and early modern agriculture. Grain market prices were highly regulated and local governmental authorities provisioned cities during periods of scarcity so adjustment to exogenous shocks was often through quantity rather than through price (for a discussion of the French case see Kaplan (2013)).

Table 6
Grain Price Regressions

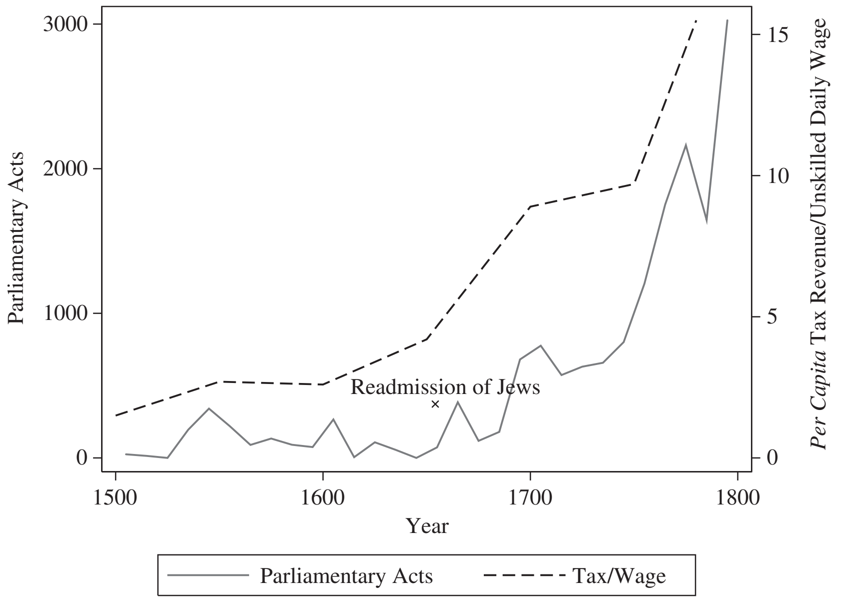
	Dependent variable: wheat prices (log)					
	(1)	(2)	(3)	(4)	(5)	(6)
Temperature	−8.96***	−4.43***	−1.68**	−6.51***	−1.81	−0.89
	(1.127)	(1.520)	(0.817)	(1.369)	(1.598)	(0.944)
Pre-1600 × *Temperature*				−18.34***	−7.866***	−2.451
				(2.834)	(6.190)	(2.791)
Pre-1600				−59.11***	−164.4***	−68.78***
				(6.530)	(7.225)	(4.297)
Temperature + *Interaction*				−24.86***	−9.67*	−3.344
				(1.996)	(5.202)	(2.333)
Lag Grain Prices	No	No	Yes	No	No	Yes
Market dummies	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	No	Yes	Yes	No	Yes	Yes
N	16,171	16,171	15,193	16,171	16,171	15,193
Adjusted R^2	0.008	0.594	0.771	0.219	0.594	0.771

Notes. *p < 0.05, **p < 0.01, ***p < 0.001. Observations are at the city × year level between 1100 and 1799. The dependent variable is the log of wheat prices in silver equivalents. Coefficients are multiplied by 100 and reported with standard errors clustered at the city level.

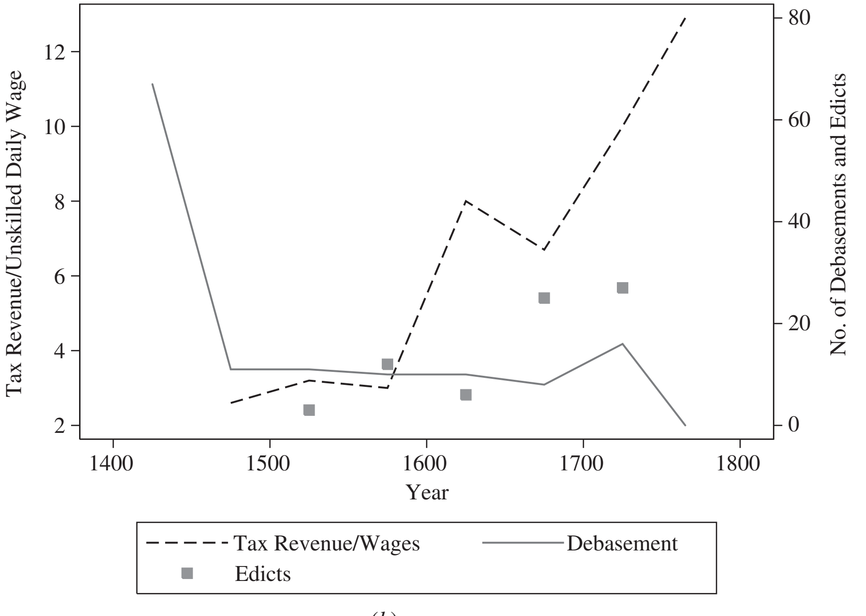
In columns (4)–(6), we assess whether temperature shocks affected grain prices less after 1600 than before by interacting temperature with a dummy variable for all periods before 1600. The fixed effects specification implies that a one degree centigrade decrease in average temperature is associated with a 24% increase in grain prices (column 4) before 1600. This suggests that increased market integration after 1600 reduced vulnerability to climatic shocks. Similar to the regressions on the whole sample, when we include time dummies and a lag of the dependent variable, these effect sizes shrink considerably. Overall, these results suggest that better markets and improvements in agricultural technology did mean that European economies were less vulnerable to climate shocks after 1600. Nevertheless, while the effect of climate on agricultural prices weakened after 1600, it did not disappear. Therefore, improvements in market integration are unlikely to be solely responsible for the marked decline in Jewish persecutions that occurred in the early modern period.

5.3. *Greater State Capacity*?

Our conceptual framework suggests that in societies with greater state capacity the relationship between temperature shocks and Jewish persecutions should be weaker. We also find significant support for this proposition from the results we obtain using our *Low State Antiquity* variables. These regressions indicate that the link between persecution and colder temperatures was strongest in states of more recent origin. Unfortunately, it is difficult to test this hypothesis more directly since reliable and continuous data on tax revenues and other measures of state capacity are only available for the major European states after 1500 (and in some cases 1650) (Dincecco, 2009;



(*a*)

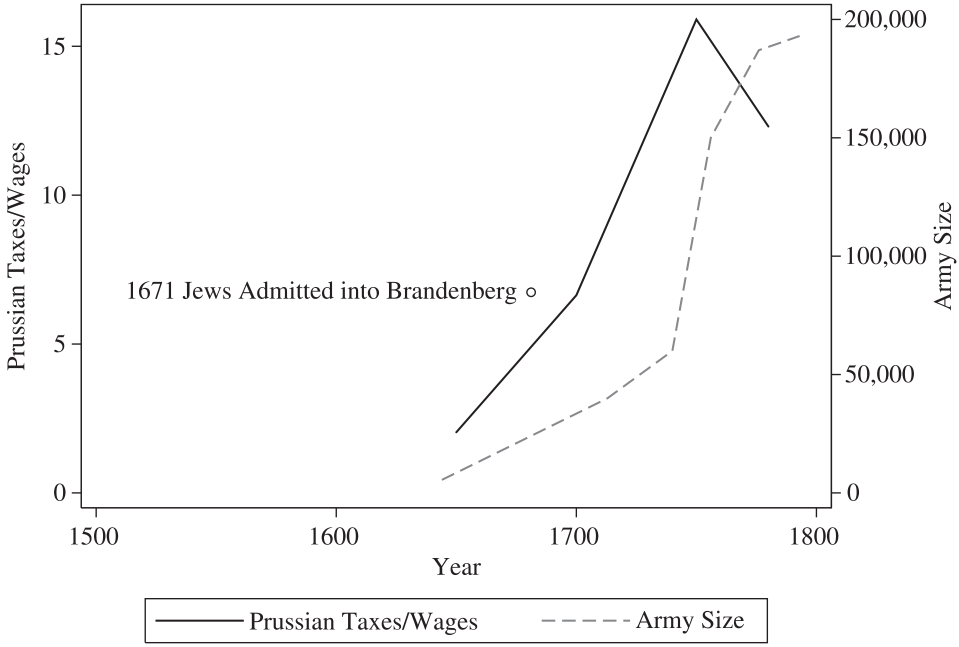


(*b*)

Fig. 5. *The Rise of State Capacity in Early Modern Western Europe (a) England (b) France (c) Dutch Republic (d) Prussia*

Notes. Tax revenue data is from Karaman and Pamuk (2013); data on English Parliamentary Acts is from Bogart and Richardson (2011). Data on Royal Edicts is from Johnson and Koyama (2014*a*); data on debasements is from Shaw (1896). Army size data is from van Nimwegen (2006).

(*c*)



(*d*)

Fig. 5. *(Continued)*

Karaman and Pamuk, 2013).[48] The point at which systematic data becomes available not surprisingly coincides with the rise of strong centralised states. Furthermore, estimates of tax revenues generally do not exist for the many city-states and smaller political units that comprise much of our data.

Significant narrative evidence supports our argument that increases in fiscal capacity in western Europe were linked to the decision to admit and protect Jewish communities. Figure 5*a* depicts the rise of state capacity in England as measured by tax revenue and the increase in legislative activity by Parliament. For example, Oliver Cromwell invited Jews to return to England in 1655 – a period during which state capacity was expanding in England (Kaplan, 2007, p. 326). The English Jewish community was initially viewed as a transient group of alien merchants with limited rights. Their position was uncertain and in 1660 a petition came before Parliament to expel them. This petition was ignored but it was only after the Glorious Revolution that the permanent status of Jews in England was fully recognised and accepted (Katz, 1994, pp. 140–1, 188). Despite the unpopularity of the English Jewish community, they were no longer subject to persecutions and violence after this official recognition.[49]

In the English case, it is difficult to disentangle the importance of state capacity in protecting the Jews from persecution from the role Parliament may have played in protecting them. However, this is not the case in France where a similar process took place under the auspices of an absolutist monarchy. Figure 5*b* traces the dramatic increase in the capacity of the central state after around 1630, using tax revenues and counts of royal edicts issued. Cardinal Richelieu played a crucial role in establishing the French tax state and in protecting Portuguese crypto-Jews from being persecuted as heretics because of their value as merchants and financiers. Israel (1985, pp. 96–7) describes this as 'a classic instance of *raison d'État* politics and mercantilism' the result of which was to have 'made possible that steady transition from the 1630s down to the 1680s by when the Portuguese communities in France had cast off all remaining pretence and openly organised as Jewish congregations with rabbis and services in Hebrew'. By 1722, the right of all French Jews to openly practice their religion was recognised in law.

The Dutch Republic offered permanent protection to Jews after its declaration of independence from Spain, with large numbers of the so-called crypto-Jews arriving in 1593. The rights of Jews to practice their religion was codified in 1619. Figure 5*c* plots the relationship between toleration offered to the Jews and the rise of the Dutch state as measured by taxation *per capita* over real wages and by the wartime strength of the Republic's armed forces. Figure 5*d* depicts similar data for Prussia. While there had been a long history of Jewish settlement in lands controlled by Prussia, it was only in the late seventeenth century that Frederick William (1650–88) gave the Jews a charter, which established their permanent residency. This occurred at the same time as the Elector invested in fiscal capacity

[48] In online Appendix D, Figure D3 depicts the rise in tax revenues (measured in silver) for the seven largest European states between 1500 and 1800.

[49] For details on the survival of antisemitic stereotypes and attitudes in England after the re-admittance of Jews into the country see Poliakov (1955, pp. 203–9) and Felsenstein (1999).

and built a professional standing army that would propel Prussia to the status of a major European power.

There can be no doubt that popular antisemitism survived the emergence of stronger nation states in the early modern period.[50] But the evidence suggests that these new states were less responsive to it. The increases in state capacity that occurred from 1600 onwards, documented by Dincecco (2009); Karaman and Pamuk (2013) and Johnson and Koyama (2014*a*), led to the formation of polities that were less vulnerable to political unrest and better at reducing interfaith violence, all factors that led to fewer persecutions and expulsions.[51] This is consistent with the findings that stronger states were responsible for ending the European witch-hunts in the late seventeenth century (Levack, 1996; Johnson and Koyama, 2014*b*) and with the argument that the rise of larger and more centralised states led to a gradual increase in bounds of religious toleration in the early modern period (Johnson and Koyama, 2013).[52]

Jews continued to suffer persecutions and massacres in early modern Europe but these occurred in the ungoverned periphery and not in the new nation states of western Europe. The worst massacres occurred during the Khmelnytsky Uprising, which saw the Ukraine breakaway from Poland-Lithuania in the mid-seventeenth century (Stampfer, 2003). It goes without saying that this increase in state capacity was a two-edged sword: it could be used to persecute as well as protect. In the twentieth century, the capacity of modern states made possible the industrial horrors of the Holocaust. But in the period between 1600 and 1800, it was associated with a reduction in violence against minority groups.

5.4. *Colder Temperature?*

The period 1400 to 1800 is known as the Little Ice age. This name is perhaps slightly misleading as there was a lot of variation in climate within this long period. For example, Crowley and Lowery (2000) note that the medieval warm period comprised three distinct and temporal separate peaks in temperature: 1010–1040, 1070–1105, and 1155–1190 and that average temperatures in the medieval warm period were only 0.2°C warmer than during the Little Ice Age. Consequently, some scholars have questioned

[50] There is little evidence of a lessening in antisemitic attitudes. *Judensau* – woodcut images denigrating Jews – remained common in Germany until 1800. Poliakov (1955, pp. 174–202) examines a large number of antisemitic treatises published in France during the seventeenth century that suggest that antisemitism was widespread and conventional in both elite and popular circles.

[51] Historians and sociologists have also argued that the birth of new nation states in the late medieval period was often accompanied by the expulsion of the Jews and other ‘alien’ populations (Baron, 1967*a*; Menache, 1987; Barkey and Katznelson, 2011). However, this was not in general true of medieval persecutions or expulsions. For studies of the expulsion of Jews from England see Leonard (1891), Elman (1937), Ovrut (1977), Menache (1987), Stacey (1997, 2000), Mundill (1998), Katznelson (2005), Koyama (2010*b*).

[52] According to Heckscher (1955, p. 305): ‘The same tendency is manifested in the fact that the Jews were placed on a new footing in the seventeenth century in most western and central European countries. This should certainly not be regarded as a general pro-Jewish feeling on the part of mercantilists. No such sentiment was ever felt among those in power . . . this much is clear, that the leaders of mercantilist policy wished to extend toleration even to the Jews, and that this toleration was determined primarily by commercial considerations’.

the value of terms such as the 'medieval warm period' or the 'Little Ice Age' because within period variation is often much larger than between-period variation (Kelly and Gráda, 2014).[53]

In our data, average temperatures in Europe between 1400 and 1600 were between 0.10 and 0.20 degrees cooler than during the surrounding centuries. Nevertheless, even though the decline in mean temperature was modest, the period after 1400 saw greater temperature volatility. In particular, 'bad weather – heavy rainfall, cool and wet summers, severe floods – became much more frequent during the last two centuries of the Middle Ages and suggest that, at least in north-western Europe, climatic disasters were in fact more numerous and severe than they had been earlier. This is supported by other evidence: the extension of the glaciers in the Alps; the lowering of the upward limits of cultivation and of tree growth in hilly areas; the inundation of the coastal lowlands in the Netherlands and the increasing soil moisture in the valley of central Europe, where, in some instances, cultivation had to be abandoned' (Pounds, 1974, p. 136).

Does an improvement in temperature account for the decline in persecutions? In our data, summer growing conditions improved in the seventeenth century but the late seventeenth century again saw extremely cold winters due to a decline in solar activity known as the Maunder Minimum. Indeed, many scholars have argued that cold weather and particularly low winter temperatures during this period were associated with the political turbulence known as the crisis of the seventeenth century (Parker, 2013). Certainly, a sustained improvement in climatic conditions did not begin until the eighteenth century. Thus, it is unlikely that improving climatic conditions can explain the decline in Jewish persecutions.

5.5. *Changes in Values and Beliefs*?

A final factor we do not consider in detail is the importance of changing cultural values and beliefs, as emphasised by Mokyr (2002, 2009). The Reformation did not lead to a marked decline in religious tension or antisemitism. Erasmus, the leading advocate of Christian humanism, is viewed by historians as an advocate of greater religious toleration, at least for Trinitarian Christians (Zagorin, 2003, pp. 50–63). However, he did not favour religious pluralism and 'would have had no patience with the modern, enlightened idea of of toleration – of individual rights that extend to every race and creed' (Oberman, 1981, p. 39). In particular, his lenient attitude towards other Christians did not mean that he favoured extending better treatment to Jews for whom he had an 'unbound hatred' suspecting them of a 'collective conspiracy' and viewing them as 'culpable as the wirepullers of the German Peasant's War (Oberman, 1981, p. 38).[54] Martin Luther expressed increasingly antisemitic views once he realised that the Reformation would not win over large numbers of Jewish converts; he penned the

[53] Kelly and Gráda (2014) contend that there was no decrease in temperature during the late middle ages. However, their argument remains contested by climate scientists and historians (Büntgen and Hellmann, 2014; White, 2014).

[54] Whether Erasmus's anti-Judaism is sufficiently virulent to represent antisemitism is a subject of scholarly debate (Markish, 1986).

book *The Jews and their Lies* in 1543 and railed against them for usury: 'they [the Jews] are nothing but thieves and robbers who daily eat no morsel and wear no thread of clothing which they have not stolen and pilfered from us by means of their accursed usury'. He was also an advocate of expulsion: 'eject them forever from this country. For, as we have heard, God's anger with them is so intense that gentle mercy will only tend to make them worse and worse, while sharp mercy will reform them but little' (Luther, 1553 [1971], Chapter 15).

From the end of the seventeenth century onwards, however, the Enlightenment may have played a role in reducing antipathy towards Jews at least among elites (Kamen, 1967; Grell and Porter, 2000). Data do not exist that shed light on the role played by the Enlightenment in increasing religious toleration. Certainly, by de-emphasising the importance of revealed religion, the Enlightenment created a religiously neutral sphere where Christians and Jews could meet on an equal footing (Low, 1979). Nevertheless many Enlightenment Figures including Voltaire, Edward Gibbon and Edmund Burke voiced anti-Jewish views (Sutcliffe, 2000). John Locke was in favour of granting toleration to Jews but this was because he believed it would encourage their conversion to Christianity (Matar, 1993). Voltaire described the Jewish nation as 'the most detestable ever to have sullied the earth' (Sutcliffe, 2000, p. 32). It was only in the late eighteenth century that Enlightenment views began to exert a decisive influence on the treatment of Jews in Europe, generating the move towards Jewish emancipation. This intellectual movement, shaped by Moses Mendelssohn (1729–86), Gotthold Lessing (1729–81) and Christian von Dohm (1751–1820), and many others, came too late to help explain the end of large-scale Jewish persecutions in western and central Europe.[55] Moreover, when Jewish emancipation did arrive at the end of the eighteenth century, it was shaped as much by the desire of rulers to make better economic use of their Jewish populations as it was by Enlightenment philosophy.[56]

6. Conclusion

This article examines the effect of negative supply shocks on the treatment of religious or ethnic minorities. We develop a simple conceptual framework to study the conditions under which rulers find it beneficial to expel or expropriate a minority community. In our empirical analysis, we exploit the fact that the economies of medieval and early modern Europe were predominantly agrarian and use exogenous variation in temperature during the growing season to identity the effect of supply shocks on the probability of a Jewish community suffering persecution. A one standard deviation decrease in average temperature increased the probability of a Jewish community being persecuted from a baseline of 2% every five years to between 2.5% and 3%.

[55] Mendelssohn, however, did play a role in preventing an expulsion of Jews from Endlingen and Lengnau by writing to Johann Kaspar Lavater in 1774 (Hochman, 2014).

[56] The Habsburg emperor Joseph II began the process of granting Jews civic rights in 1782. But it was the French Revolution and the subsequent invasion of Germany by French armies that led to the imposition of Jewish emancipation in central Europe (Berkovitz, 1989; Vital, 1999). After the defeat of France, these reforms were partially reversed but the movement towards Jewish emancipation resumed and culminated with the removal of all disabilities on Jews in Austria-Hungary in 1868 and Germany in 1870 (Katz, 1974; Mahler, 1985; Sorkin, 1987).

We argue that more developed states with greater fiscal capacity and greater political stability were less likely to expel Jewish communities as a result of periods of cold temperature. Our results support this hypothesis: the effect of supply shocks on persecutions was greater in societies with lower state capacity. Persecutions peaked in the fourteenth to sixteenth centuries. Increased agricultural productivity, greater market integration and the rise of centralised states helped account for Europe's gradual transition from extractive to inclusive economic and political institutions during this period and in the establishment of a degree of protection for religious minorities.

University of Michigan–Dearborn
George Mason University

Submitted: 30 December 2013
Accepted: 2 July 2015

Additional Supporting Information may be found in the online version of this article:

Appendix A. Descriptive Statistics.
Appendix B. Further Robustness Tests.
Appendix C. Data.
Appendix D. Additional Historical Evidence and Discussion.
Data S1.

References

Acemoglu, D. (2003). 'Why not a political Coase Theorem? Social conflict, commitment and politics', *Journal of Comparative Economics*, vol. 31(4), pp. 620–52.
Acemoglu, D., Hassan, T.A. and Robinson, J.A. (2011). 'Social structure and development: a legacy of the Holocaust in Russia', *Quarterly Journal of Economics*, vol. 126(2), pp. 895–946.
Acemoglu, D., Johnson, S. and Robinson, J. (2005). 'The rise of Europe: Atlantic trade, institutional change, and economic growth', *American Economic Review*, vol. 95(3), pp. 546–79.
Acemoglu, D. and Robinson, J.A. (2012). *Why Nations Fail*, New York: Crown Business.
Allen, R.C. (2000). 'Economic structure and agricultural productivity in Europe, 1300–1800', *European Review of Economic History*, vol. 4(01), pp. 1–25.
Anderson, R.W. (2012). 'Measuring the Portuguese Inquisition', Memo, University of Michigan-Dearborn.
Bai, Y. and Kai-sing Kung, J. (2011). 'Climate shocks and Sino-nomadic conflict', *The Review of Economics and Statistics*, vol. 93(3), pp. 970–81.
Barber, M. (1981*a*). 'Lepers, Jews and Moslems: the plot to overthrow Christendom in 1321', *History*, vol. 66 (216), 1–17.
Barber, M. (1981*b*). 'The Pastoureaux of 1320', *Journal of Ecclesiastical History*, vol. 32(2), pp. 144–66.
Barkey, K. and Katznelson, I. (2011). 'States, regimes, and decisions: why Jews were expelled from medieval England and France', *Theory and Society*, vol. 40(5), pp. 475–503.
Baron, S.W. (1965*a*). *A Social and Religious History of the Jews, Volume IX: Under Church and Empire*, New York: Columbia University Press.
Baron, S.W. (1965*b*). *A Social and Religious History of the Jews, Volume X: On the Empire's Periphery*, New York: Columbia University Press.
Baron, S.W. (1967*a*). *A Social and Religious History of the Jews, Volume XI: Citizen or Alien Conjurer*, New York: Columbia University Press.
Baron, S.W. (1967*b*). *A Social and Religious History of the Jews, Volume XII: Economic Catalyst*, New York: Columbia University Press.
Baron, S.W. (1975). *Economic History of the Jews*, Jerusalem: Keter Publishing House (edited by Nachum Gross).
Barzel, Y. (1992). 'Confiscation by the ruler: the rise and fall of Jewish lending in the Middle Ages', *Journal of Law and Economics*, vol. 35(1), pp. 1–13.

Berkovitz, J.A. (1989). *The Shaping of Jewish Identity in Nineteenth-century France*, Detroit, MI: Wayne State University Press.
Besley, T. and Persson, T. (2011). *Pillars of Prosperity*, Princeton, NJ: Princeton University Press.
Bockstette, V., Chanda, A. and Putterman, L. (2002). 'States and markets: the advantage of an early start', *Journal of Economic Growth*, vol. 7(4), pp. 347–69.
Bogart, D. and Richardson, G. (2011). 'Property rights and parliament in industrializing Britain', *Journal of Law and Economics*, vol. 54(2), pp. 241–74.
Bosker, M., Buringh, E. and van Zanden, J.L. (2013). 'From Baghdad to London: unravelling urban development in Europe and the Arab world 800–1800', *Review of Economics and Statistics*, vol. 95(4), pp. 1418–37.
Botticini, M. (1997). 'New evidence on Jews in Tuscany, CA. 1310–1435: the 'friends & family' connection again', *Zakhor. Rivista di Storia degli Ebrei d'Italia*, vol. 1, pp. 77–93.
Botticini, M. (2000). 'A tale of 'benevolent' governments: private credit markets, public finance, and the role of Jewish lenders in Medieval and Renaissance Italy', *Journal of Economic History*, vol. 60(1), pp. 164–89.
Botticini, M. and Eckstein, Z. (2012). *The Chosen Few*, Princeton, New Jersey: Princeton University Press.
Box-Steffensmeier, J. and Jones, B. (2004). *Event History Analysis: A Guide for Social Scientists*, Cambridge: Cambridge University Press.
Brown, R.B. and McCartney, S. (2005). 'The exchequer of the Jews revisited: the operation and effect of the Saccarium Judeorum', *Medieval History Journal*, vol. 8(2), pp. 303–22.
Büntgen, U. and Hellmann, L. (2014). 'The little ice age in scientific perspective: cold spells and caveats', *Journal of Interdisciplinary History*, vol. 44(3), pp. 353–68.
Campbell, B.M. (2010). 'Nature as historical protagonist', *Economic History Review*, vol. 63(2), pp. 281–314.
Chaney, E. (2013). 'Revolt on the Nile: economic shocks, religion and political power', *Econometrica* vol. 81 (5), pp. 2033–53.
Chazan, R. (1973–74). 'Anti-usury efforts in thirteenth century Narbonne and the Jewish response', *Proceedings of the American Academy for Jewish Research*, vol. 41, pp. 45–67.
Chazan, R. (2006). *The Jews of Western Christendom*, Cambridge: Cambridge University Press.
Chazan, R. (2010). *Reassessing Jewish Life in Medieval Europe*, Cambridge: Cambridge University Press.
Chua, A. (2004). *World on Fire: How Exporting Free Market Democracy Breeds Ethnic Hatred and Global Instability*, New York: Anchor Books.
Conley, T.G. (2008). 'Spatial econometrics', in (S.N. Durlauf and L.E. Blume, eds.), *The New Palgrave Dictionary of Economics*, pp. 741–7, Basingstoke: Palgrave Macmillan.
Crafts, N. and Mills, T.C. (2009). 'From Malthus to Solow: how did the Malthusian economy really evolve?', *Journal of Macroeconomics*, vol. 31(1), pp. 68–93.
Cramer, A.C. (1940). 'The Jewish Exchequer, an inquiry into its fiscal function', *American Historical Review*, vol. 45(2), pp. 327–37.
Crowley, T.J. and Lowery, T.S. (2000). 'How warm was the medieval warm period?', *Ambio*, vol. 29(1), pp. 51–4.
De Long, J.B. and Shleifer, A. (1993). 'Princes and merchants: European city growth before the industrial revolution', *Journal of Law & Economics*, vol. 36(2), pp. 671–702.
Dell, M., Jones, B. and Olken, B. (2012). 'Temperature shocks and economic growth: evidence from the last half century', *American Economic Journal: Macroeconomics*, vol. 4(3), pp. 66–95.
Dell, M., Jones, B.F. and Olken, B.A. (2014). 'What do we learn from the weather? The new climate-economy literature', *Journal of Economic Literature*, vol. 53(3), pp. 740–98.
Dincecco, M. (2009). Fiscal centralization, limited government, and public revenues in Europe, 1650–1913', *Journal of Economic History*, vol. 69(1), 48–103.
Dobson, B. (2003). 'The medieval York Jewry reconsidered', in (P. Skinner, ed.), *The Jews in Medieval Britain: Historical, Literary, and Archaeological Perspectives*, pp. 145–56, New York: Boydell and Brewer.
Dubnow, S.M. (1975). *History of the Jews in Russia and Poland*, Volume I. Ktav Publishing House (translated by I. Friedlaender).
Durante, R. (2009). Risk, cooperation and the economic origins of social trust: an empirical investigation. MPRA Paper 25887, University Library of Munich.
Elman, P. (1937). 'The economic causes of the expulsion of the Jews in 1290', *Economic History Review*, vol. 7(2), pp. 145–54.
Emery, R.W. (1959). *The Jews of Perpignan in the Thirteenth Century: An Economic Study Based on Notoral Records*, New York: Columbia University Press.
Encyclopedia Judaica (2007). 2nd edn, Detroit, MI: Thomson-Gale.
Felsenstein, F. (1999). *Anti-Semitic Stereotypes: A Paradigm of Otherness in English Popular Culture, 1660–1830*, Baltimore, MD: Johns Hopkins University Press.
Fenske, J. and Kala, N. (2013). 'Climate, ecosystem resilience and the slave trade', CEPR Discussion Paper no. 9449.

Fischer, G., van Nelthuizen, H., Shah, M. and Nachtergaele, F. (2002). *Global Agro-ecological Assessment for Agriculture in the 21st Century: Methodology and Results*, Rome: Food and Agriculture Organization of the United Nations.

Galloway, P.R. (1986). 'Long-term fluctuations in climate and population in the preindustrial era', *Population and Development Review*, vol. 12(1), pp. 1–24.

Gerber, J.S. (1992). *The Jews of Spain: A History of the Sephardic Experience*, New York: The Free Press.

Glaeser, E.L. (2005). 'The political economy of hatred', *Quarterly Journal of Economics*, vol. 120(1), pp. 45–86.

Greene, W. (2004). 'The behaviour of the maximum likelihood estimator of limited dependent variable models in the presence of fixed effects', *Econometrics Journal*, vol. 7(1), pp. 98–119.

Grell, O.P. and Porter, R. (2000). 'Toleration in enlightenment Europe', in (O.P. Grell and R. Porter, eds.), *Toleration in Enlightenment Europe*, pp. 1–23, Cambridge: Cambridge University Press.

Grosfeld, I., Rodnyansky, A. and Zhuravskaya, E. (2013). 'Persistent anti-market culture: a legacy of the Pale of Settlement after the Holocaust', *American Economic Journal: Economic Policy*, vol. 5(3), pp. 189–226.

Guiot, J. and Corona, C. (2010). 'Growing season temperature in Europe and climate forcings over the past 1400 years', *Plos One*, vol. 5(4), pp. 1–15.

Haliczer, S.H. (1973). 'The Castilian urban patriciate and the Jewish expulsions of 1480–92', *American Historical Review*, vol. 78(1), pp. 35–62.

Heckscher, E.F. (1955). *Mercantilism*, Volume II. London: George Allen & Unwin (translated by E.F. Soderlund).

Hochman, L. (2014). *The Ugliness of Moses Mendelssohn: Aesthetics, Religion, and Morality in the Eighteenth Century*, London: Routledge.

Horowitz, D. (2001). *The Deadly Ethnic Riot*, Berkeley, CA: University of California Press.

Hsiang, S.M. (2010). 'Temperatures and cyclones strongly associated with economic production in the Caribbean and Central America', *Proceedings of the National Academy of Sciences*, vol. 107(35), pp. 15367–72.

Hsiang, S. and Burke, M. (2014). 'Climate, conflict, and social stability: what does the evidence say?', *Climate Change*, vol. 123(1), pp. 39–55.

Hsiang, S., Burke, M. and Miguel E. (2013). Quantifying the influence of climate on human conflict. *Science*, vol. 341(6151), doi: 10.1126/science.1235367.

Israel, J. (1985). *European Jewry in the Age of Mercantilism, 1550–1750*, Oxford: Oxford University Press.

Jia, R. (2014). 'Weather shocks, sweet potatoes and peasant revolts in historical China', ECONOMIC JOURNAL, vol. 124(575), pp. 92–118.

Johnson, N.D. and Koyama, M. (2013). 'Legal centralization and the birth of the secular state', *Journal of Comparative Economics*, vol. 41(4), pp. 959–78.

Johnson, N.D. and Koyama, M. (2014*a*). 'Tax farming and the origins of state capacity in England and France', *Explorations in Economic History*, vol. 51(1), pp. 1–20.

Johnson, N.D. and Koyama, M. (2014*b*). 'Taxes, lawyers, and the decline of witch trials in France', *Journal of Law and Economics*, vol. 57(1), pp. 77–112.

Jones, B. and Olken, B. (2010). 'Climate shocks and exports', *American Economic Review: Papers and Proceedings*, vol. 100(2), pp. 454–9.

Jordan, W.C. (1989). *The French Monarchy and the Jews: From Philip Augustus to the Last Capetians*, Philadelphia, PA: University of Pennsylvania Press.

Jordan, W.C. (1998). 'Jews, regalian rights, and the constitution in Medieval France', *AJS Review*, vol. 23(1), pp. 1–16.

Kamen, H. (1967). *The Rise of Toleration*, New York: World University Library.

Kamen, H. (1988). 'The Mediterranean and the expulsion of Spanish Jews in 1492', *Past & Present*, vol. 119 (May), pp. 30–55.

Kaplan, B. (2007). *Divided by Faith*, Cambridge, MA: Harvard University Press.

Kaplan, S. (2013). *Bread, Politics and Political Economy in the Reign of Louis XV: Anthem European Studies*. Anthem Other Canon Economics Series, London: Anthem Press.

Karaman, K. and Pamuk, S. (2013). 'Different paths to the modern state in Europe: the interaction between warfare, economic structure and political regime', *American Political Science Review*, vol. 107(3), pp. 603–26.

Katz, J. (1974). *Out of the Ghetto*, Cambridge, MA.: Harvard University Press.

Katz, D.S. (1994). *The Jews in the History of England, 1485–1850*, Oxford: Clarendon Press.

Katznelson, I. (2005). '"To give counsel and to consent": Why the king Edward I expelled his Jews (in 1290)', in (I. Katznelson and B.R. Weingast, eds.), *Preferences and Situations*, pp. 88–126, New York: Russell Sage Foundation.

Kelly, M. and Gráda, C.Ó. (2014). 'The waning of the little ice age: climate change in early modern Europe', *Journal of Interdisciplinary History*, vol. 44(3), pp. 301–25.

Koyama, M. (2010*a*). 'Evading the "taint of usury": the usury prohibition as a barrier to entry', *Explorations in Economic History*, vol. 47(4), pp. 420–42.

Koyama, M. (2010*b*). 'The political economy of expulsion: the regulation of Jewish moneylending in medieval England', *Constitutional Political Economy*, vol. 21(4), pp. 374–406.

Langmuir, G.I. (1990). *Toward a Definition of Antisemitism*, Berkeley, CA: University of California Press.
Leonard, G.H. (1891). 'The expulsion of the Jews by Edward I an essay in explanation of the Exodus, A.D. 1290', *Transactions of the Royal Historical Society*, vol. 5(December), pp. 103–46.
Levack, B.P. (1996). 'State-building and witch hunting in early modern Europe', in (J. Barry, M. Hester, and G. Roberts, eds.), *Witchcraft in Early Modern Europe*, pp. 96–118, Cambridge: Cambridge University Press.
Lipman, V.D. (1967). *The Jews of Medieval Norwich*, London: Jewish Historical Society of England (edited by A.M. Habermann), with an Appendix of Latin documents from the Westminster Abbey Muniment Room; and the Hebrew Poems of Meir of Norwich (edited by A.M. Habermann).
Low, A.F. (1979). *Jews in the Eyes of Germans: from the Enlightenment to Imperial Germany*. Michigan, MI: Institute for the study of Human Issues.
Luther, M. (1553) [1971]. 'On the Jews and their lies', in (F. Sherman, ed.), *Luther's Works, Vol. 47: The Christian in Society IV*, pp. 121–306. Minneapolis, MN: Fortress Press.
Maccini, S. and Yang, D. (2009). 'Under the weather: health, schooling, and economic consequences of early-life rainfall', *American Economic Review*, vol. 99(3), pp. 1006–26.
Madesam, A., Shoag, D., Veuger, S. and Yanagizawa-Drott, D. (2013). 'Do political protests matter? Evidence from the tea party movement', *Quarterly Journal of Economics*, vol. 128(4), pp. 16633–85.
Mahler, R. (1985). Hasidism and the Jewish Enlightenment, Philadelphia, PA: The Jewish Publication Society of America. translated from Yddish by Eugene Orenstein, translated from Hebrew by Aaron Klein and Jenny Machlowitz Klein.
Malik, A. and Temple, J.R. (2009). 'The geography of output volatility', *Journal of Development Economics*, vol. 90(2), pp. 163–78.
Markish, S. (1986). *Erasmus and the Jews*, Chicago, IL: University of Chicago Press.
Masschaele, J. (1993). 'Transport costs in medieval England', *Economic History Review*, vol. 46(2), pp. 266–79.
Matar, N.I. (1993). 'John Locke and the Jews', *Journal of Ecclesiastical History*, vol. 44(1), 45–62.
Menache, S. (1985). 'Faith, myth, and politics: the sterotype of the Jews and their expulsion from England and France', *Jewish Quarterly Review*, vol. 75(4), pp. 351–74.
Menache, S. (1987). 'The king, the Church and the Jews: some considerations on the expulsions from England and France', *Journal of Medieval History*, vol. 13(3), pp. 223–36.
Menache, S. (1997). 'Mathew Paris's attitudes toward Anglo-Jewry', *Journal of Medieval History*, vol. 23(2), pp. 139–62.
Miguel, E. (2005). 'Poverty and witch killing', *Review of Economic Studies*, vol. 72(4), pp. 1153–72.
Mitra, A. and Ray, D. (2013). Implications of an economic theory of conflict: Hindu-Muslim violence in India. NBER Working Paper 19090, National Bureau of Economic Research, Inc.
Mokyr, J. (2002). *The Gift of Athena: Historical Origins of the Knowledge Economy*, Princeton, NJ: Princeton UP.
Mokyr, J. (2009). *The Enlightened Economy*, New Haven, CT: Yale University Press.
Moore, R.I. (1992). 'Anti-Semitism and the Birth of Europe', in (D. Wood, ed.) *Christianity and Judaism, Studies in Church History, vol. 29*, pp. 33–57, Woodbridge, UK: Boydell & Brewer.
Moore, R.I. (2008). 'The war against heresy in medieval Europe', *Historical Research*, vol. 81(212), pp. 189–210.
Mundill, R.R. (1991). 'Lumbard and Son: the businesses and debtors of two Jewish moneylenders in late thirteenth-century England', *Jewish Quarterly Review*, vol. 82, pp. 137–70.
Mundill, R.R. (1998). *England's Jewish Solution: Experiment and Expulsion, 1262–1290*. Cambridge: Cambridge University Press.
Mundill, R.R. (2010). *The King's Jews: Money, Massacre and Exodus in Medieval England*, London: Continuum.
van Nimwegen, O. (2006). *The Dutch Army and the Military Revolutions, 1599-1688*, Woodbridge: The Boydell Press (translated by Andrew May).
Nirenberg, D. (1996). *Communities of Violence*, Princeton, NJ: Princeton University Press.
North, D.C., Wallis, J.J. and Weingast, B.R. (2009). *Violence and Social Orders: A Conceptual Framework for Interpreting Recorded Human History*, Cambridge: Cambridge University Press.
Nunn, N. and Qian, N. (2011). 'The potato's contribution to population and urbanization: evidence from a historical experiment', *Quarterly Journal of Economics*, vol. 126(2), pp. 593–650.
Oberman, H.A. (1981). *The Roots of Anti-Semitism*. Philadelphia, PA: Fortress Press. translated by James I. Porter.
Oster, E. (2004). 'Witchcraft, weather and economic growth in Renaissance Europe', *Journal of Economic Perspectives*, vol. 18(1), pp. 215–28.
Ovrut, B.D. (1977). 'Edward I and the expulsion of the Jews', *Jewish Quarterly Review*, vol. 67, pp. 224–35.
Parker, G. (2013). *Global Crises: War, Climate Change and Castastrophe in the Seventeenth Century*, New Haven, CT: Yale University Press.
Pascali, L. (2015). Banks and development: Jewish communities in the Italian Renassiance and current economic performance. *Review of Economics and Statistics*, forthcoming.
Pauling, A., Luteracher, J., Casty, C. and Wanner H. (2006). 'Five hundred years of gridded high-resolution precipitation reconstructions over europe and the connection to large-scale circulation', *Climate Dynamics*, vol. 26(4), pp. 387–405.

Pinker, S. (2011). *The Better Angels of Our Nature: Why Violence has Declined*, London: Viking.
Poliakov, L. (1955). *The History of Anti-Semitism*, Volume 1. Philadelphia, PA: University of Pennsylvania Press (translated by Richard Howard).
Porter, J.R. and Gawith, M. (1998). 'Temperatures and the growth and development of wheat: a review', *European Journal of Agronomy*, vol. 10(1), pp. 23–36.
Porter, J.R. and Semenov, M.A. (2005). 'Crop responses to climatic variation', *Philosophical Transactions of the Royal Society*, vol. 360, pp. 2021–35.
Pounds, N. (1974). *An Economic History of Medieval Europe*, London: Longman.
Richardson, H. (1960). *The English Jewry under Angevin Kings*, London: Methuen.
Roth, C. (1961). 'The economic history of the Jews', *Economic History Review*, vol. 14(1), pp. 131–5.
Roth, N. (1995). *Conversos, Inquisition, and the Expulsion of the Jews from Spain*. Madison, WI: The University of Wisconsin Press.
Shaw, W. (1896). *The History of Currency, 1252 to 1894*, 2nd edn, New York: Burt Franklin.
Slavin, P. (2012). 'The Great Bovine Pestilence and its economic and environmental consequences in England and Wales, 1318–50', *Economic History Review*, vol. 65(4), pp. 1239–66.
Sorkin, D. (1987). 'The genesis of the ideology of emancipation: 1806–1840', *Leo Baeck Institute Yearbook* 32 (1), pp. 11–40.
Stacey, R.C. (1985). 'Royal taxation and the social structure of medieval Anglo-Jewry: the tallages of 1239-1242', *Hebrew Union College Annual*, vol. 56, pp. 175–249.
Stacey, R.C. (1995). 'Jewish lending and the medieval English economy', in (R.H. Britnell and B.M. Campbell, eds.), *A Commercialising Economy, England 1086 to c. 1300*, pp. 7–27, Manchester: Manchester University Press.
Stacey, R.C. (1997). Parliamentary negotiation and the expulsion of the Jews from England. *Thirteenth Century England*, vol. 6, pp. 77–103.
Stacey, R.C. (2000). 'Antisemitism and the medieval English state', in (J.R. Maddicott and D.M. Palliser, eds.), *The Medieval State: essays presented to James Campbell*, pp. 163–77, London: Hambledon Press.
Stampfer, S. (2003). 'What actually happened to the Jews of Ukraine in 1648?', *Jewish History*, vol. 17(2), pp. 207–27.
Stein, S. (1956). 'Usury and the medieval English church courts', *Journal of Semitic Studies*, vol. 1(2), pp. 141–62.
Stow, K.R. (1981). 'Papal and royal attitudes toward jewish lending in the thirteenth century', *AJS Review*, vol. 6, pp. 161–84.
Stow, K.R. (1992). *Alienated Minority, the Jews of Medieval Latin Europe*, Cambridge, MA: Harvard University Press.
Sutcliffe, A. (2000). 'Can a Jew be a Philosophe? Isaac de Pinto, Voltaire, and Jewish participation in the Enlightenment', *Jewish Social Studies*, vol. 6(3), pp. 31–51.
Tazbir, J. (1973). *A State without States*, Warsaw: The Kosciuzko Foundaton Twayne Publishers.
Tol, R.S. and Wagner, S. (2010). 'Climate change and violent conflict in Europe over the last millennium', *Climatic Change*, vol. 99(1–2), pp. 65–79.
Trachtenberg, J. (1943). *The Devil and the Jews*, Philadelphia, PA: The Jewish Publication Society.
Vidal-Robert, J. (2013). War and inquisition: repression in early modern Spain. CAGE Working Paper No. 119, University of Warwick.
Vital, D. (1999). *A People Apart, The Jews in Europe 1789–1939*, Oxford: Oxford University Press.
Voigtländer, N. and Voth, H.-J. (2012). 'Persecution perpetuated: the medieval origins of Anti-Semitic violence in Nazi Germany', *Quarterly Journal of Economics*, vol. 127(3), pp. 1–54.
Waldinger, M. (2014). 'The economic effects of long-term climate change: evidence from the little ice age, 1500–1700', memo, London School of Economics.
Weinryb, B.D. (1972). *The Jews of Poland*, Philadelphia, PA: Jewish Publication Society of America.
White, S. (2014). 'The real little ice age', *Journal of Interdisciplinary History*, vol. 44(3), pp. 327–52.
Yamaguchi, K. (1991). *Event History Analysis*, Newbury Park, CA: Sage.
Yanagizawa-Drott, D. (2015). Propaganda and conflict: evidence from the Rwandan Genocide. *Quarterly Journal of Economics*, vol. 129(4), pp. 1633–85.
Zagorin, P. (2003). *How the Idea of Religious Toleration Came to the West*, Princeton, NJ: Princeton University Press.
Zhang, D.D., Jim, C., Lin, G., He, Y.-Q., Wang, J.J. and Lee, H.F. (2006). 'Climatic change, wars and dynastic cycles in China over the last millennium', *Climatic Change*, vol. 76(3-4), pp. 459–77.