# CONFLICT, PEACE & PROSPERITY IN THE NAME OF GOD

(ONLINE TECHNICAL APPENDICES)

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# 1 Chapter 2 Appendix

## 1.1 Estimating the Impact of Monotheism on Civilizations

Given the dataset at our disposal, we can examine the role of monotheism on the duration of civilizations as follows:

$$\begin{aligned} Duration_i &= \lambda_0 + \lambda_1 Monotheist_i + \lambda_2 Monotheist_i * Birth\ Year_i \\ &\quad + \lambda_3 Other\ Controls_i + \varepsilon_i \end{aligned} \tag{A.2.1}$$

According to equation (A.2.1), we shall see if the duration of each civilization was dependent on whether or not we classified it as monotheist. However, as the multiplicative term on the right, *Monotheist* $*$ *Birth Year*, suggests, we shall let this potential impact vary depending on when the civilization was founded. In terms of some of the other things that could have impacted how long civilizations lasted, we will also identify continent location as well as some indicators of whether the civilization was born after the births of Judaism, Christianity and Islam.

Our key results are listed in Table A.2.1. In columns (1) and (4) of this table, we see the simplest specification that controls only for the theistic attributes of civilizations, their foundation dates and geographic locations. The estimates in columns (2) and (5) add the birth of monotheism or Judaism in 606 BCE as a control and those in columns (3) and (6) include the births of Christianity (year 0) and Islam (622 CE) as well.

As shown in columns (1) through (5), we verify that the theistic attribute of a society did have a positive, statistically significant and meaningful impact on length of reign: for example, around the year 1200 CE, the estimates range from a low of about 6 extra decades (an impact of more than 18 percent on duration) to a high of about 7.5 decades (an impact of over 23 percent). In the first three columns, we see some evidence that the impact of adherence to monotheism declined over time, although on net the effect of monotheism was positive throughout the 17th century. Moreover, the negative coefficient on the *Monotheist* * *Birth Year* turns insignificant in the last three estimates that employ robust regression techniques. Nevertheless, we do find that there was a negative and secular trend over time, as indicated by the effect of *Birth Year* on the duration of civilizations in all of the six estimates shown. Finally, we do confirm that civilizations in America lasted much longer than others, followed by those in Africa, Asia and the Middle East. When the empirical tests control for the advent of monotheism in general, as they do in columns (2) and (5), or the birth of the three Abrahamic monotheistic religions, as in columns (3) and (6), they yield mixed results, although *Birth of Judaism* and *Birth of Christianity* produce positive coefficients whereas *Birth of Islam* generates negative coefficients.

**Table A.2.1:** Cross-Section Estimates, 2900 BCE - 1750 CE

Dependent Variable: Duration

| | OLS | | | Robust Regressions | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *Monotheist* | 67.9* | 59.3* | 48.5* | 36.3* | 33.3** | 28.6 |
| | (33.1) | (25.2) | (21.7) | (19.3) | (19.9) | (20.7) |
| *Monoth. * Birth Yr.* | −.015** | −.013* | −.010** | −.0088** | −.0079 | −.0065 |
| | (.0082) | (.0062) | (.005) | (.0052) | (.0052) | (.0053) |
| *Middle East* | −46.3* | −45.1* | −43.6* | −42.3* | −42.3* | −41.5* |
| | (*A*.4.57) | (*A*.4.86) | (5.31) | (5.25) | (5.25) | (5.32) |
| *Africa* | −39.6* | −38.3* | −37.0* | −36.7* | −36.7* | −36.0* |
| | (3.97) | (4.27) | (3.60) | (5.61) | (5.61) | (5.66) |
| *Europe* | −32.4* | −31.1* | −30.4* | −30.6* | −30.6* | −30.3* |
| | (3.35) | (3.40) | (3.35) | (4.91) | (4.91) | (4.97) |
| *Asia* | −35.4* | −35.1* | −34.0* | −34.9* | −34.9* | −34.2* |
| | (1.13) | (1.03) | (1.19) | (4.57) | (4.57) | (4.62) |
| *America* | 93.1* | 95.7* | 57.5* | 82.9* | 82.9* | 84.9* |
| | (10.7) | (10.4) | (15.4) | (6.59) | (6.59) | (7.53) |
| *Birth Year* | −.009* | −.013* | −.015* | −.0056* | −.0087* | −.010* |
| | (.0034) | (.0026) | (.006) | (.0016) | (.0024) | (.0034) |
| *Birth of Judaism* | ... | 10.8* | 7.79 | ... | 7.99 | 5.74 |
| | | (5.29) | (5.90) | | (5.30) | (5.63) |
| *Birth of Christ.* | ... | ... | 11.2* | ... | ... | 8.08 |
| | | | (2.13) | | | (5.16) |
| *Birth of Islam* | ... | ... | −4.83 | ... | ... | −3.01 |
| | | | (9.83) | | | (4.37) |
| *No. of obs.* | 277 | 277 | 277 | 277 | 277 | 277 |
| $R^2$ | .290 | .300 | .309 | ... | ... | ... |

Note: * and ** respectively denote significance at the 5 percent and 10 percent levels. Cols. (1) - (6) dependent variable: duration of civilization $i$ from its foundation to disintegration or termination (in years). Cols. (1) - (3): OLS estimates with errors clustered at the geographic region level. Cols.

(4) - (6): robust regression estimates. In columns (1) through (3), all errors clustered at the regional level of *MIDDLE EAST, AFRICA, EUROPE, ASIA* and *AMERICA*.

Instead of exploring if monotheism impacted the *length* of societies' existence historically, we can instead examine monotheisms impact on societies' *endurance* over time. In technical terms, this involves duration analysis the details of which can be found in our technical appendix using the exponential hazard function below:

$$\log h_{i,t} = \lambda_0 + \lambda_1 Monotheist_i + \lambda_2 Monotheist_i * Birth\ Year_i + \lambda_3 Other\ Controls_i + \upsilon_i, \quad \text{(A.2.2)}$$

where $h_{i,t}$ represents the survival hazard of civilization $i$ at time $t$. And in all estimates that follow, we shall employ the same explanatory variables we used in Table A.2.1.

Our main findings, which are shown in Table A.2.2, are strongly in line with what we have already identified: That is, as shown in all columns, there are systematic regional differences in survival: being located in Africa raised survival likelihoods the most, followed by being located in America and Europe. In contrast, being in the Middle East had a statistically significant and dampening effect on survival in all six specifications. The positive coefficients of *Birth Year* in the exponential hazard rate estimates, shown in columns (1) through (3), suggest that hazard rates rose and survival declined over time. But, since the Weibull estimates incorporate such a secular trend by construction, *Birth Year* is not statistically significant in columns (4) through (6).

Of course, the variables of primary interest are *Monotheist* and *Monotheist * Birth Year*. As shown in Table A.2.2, all survival estimates that rely on an exponential hazard rate specification produce a negative and statistically significant effect of *Monotheist t* and a statistically positive one of *Monotheist * Birth Year* on survival rates.

In sum, utilizing duration analysis, we see that monotheist societies endured about 12 to 20 years longer than non-monotheist civilizations historically. Given that societies in our sample on average lasted about 330 years, this corresponds to about 3-6 percent boost in endurance which we can attribute to monotheism.

**Table A.2.2:** Multivariate Survival Analyses with Extended data, 2900 BCE - 1750 CE

| | Hazard Rate Since Date of Foundation | | | | | |
|---|---|---|---|---|---|---|
| | Exponential Distribution | | | Weibull Distribution | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *Monotheist* | $-1.59^{*}$ | $-1.59^{*}$ | $-1.24^{*}$ | $-3.11$ | $-2.63^{**}$ | $-2.41$ |
| | (.747) | (.747) | (.519) | (2.02) | (1.60) | (1.50) |
| *Monoth. * Birth Yr.* | $.00038^{*}$ | $.00038^{*}$ | $.00029^{*}$ | .00078 | $.00065^{**}$ | $.00058^{**}$ |
| | (.00018) | (.0008) | (.00013) | (.00045) | (.00037) | (.00035) |
| *Middle East* | $.453^{*}$ | $.453^{*}$ | $.449^{*}$ | $.481^{*}$ | $.484^{*}$ | $.479^{*}$ |
| | (.048) | (.048) | (.048) | (.091) | (.095) | (.098) |
| *Africa* | $-6.60^{*}$ | $-6.60^{*}$ | $-6.76^{*}$ | $-23.6^{**}$ | $-25.3^{**}$ | $-25.9^{**}$ |
| | (.199) | (.199) | (.270) | (13.1) | (14.6) | (14.6) |
| *Europe* | $-.124^{*}$ | $-.124^{*}$ | $-.120^{*}$ | $-.171^{*}$ | $-.196^{*}$ | $-.182^{*}$ |
| | (.011) | (.011) | (.014) | (.026) | (.034) | (.032) |
| *Asia* | .053 | .053 | .056 | $-.0069$ | $-.015$ | .012 |
| | (.107) | (.107) | (.106) | (.136) | (.126) | (.124) |
| *America* | $-.654^{*}$ | $-.654^{*}$ | $-.617^{*}$ | $-.894^{*}$ | $-.875^{*}$ | $-.848^{*}$ |
| | (.129) | (.129) | (.134) | (.253) | (.241) | (.243) |
| *Birth Year* | $.00036^{*}$ | $.00036^{*}$ | $.00046^{*}$ | $-.00058$ | $-.00045$ | $-.00054$ |
| | (.0001) | (.0001) | (.00013) | (.00051) | (.00049) | (.0043) |
| *Birth of Judaism* | ... | $-.340^{*}$ | $-.273^{*}$ | ... | $-.492^{*}$ | $-.340^{**}$ |
| | | (.148) | (.139) | | (.209) | (.191) |
| *Birth of Christ.* | ... | ... | $-.367^{*}$ | ... | ... | $-.225^{**}$ |
| | | | (.047) | | | (.125) |
| *Birth of Islam* | ... | ... | .067 | ... | ... | .309 |
| | | | (.185) | | | (.193) |
| *No. of obs.* | 277 | 277 | 277 | 277 | 277 | 277 |
| *Time at Risk* | 89513 | 89513 | 89513 | 89513 | 89513 | 89513 |
| $p$ | ... | ... | ... | 3.29 | 3.48 | 3.59 |
| $H_0 : \ln p = 0$ | ... | ... | ... | Reject | Reject | Reject |

Note: * and ** respectively denote significance at the 5 percent and 10 percent levels. Cols. (1) - (6) Survival hazard estimates with failure event being the expiration date of each civilization. Columns (1) through (3) show estimates with the exponential hazard specification. Columns (4) through (6) show those with the Weibull distribution. All errors clustered at the regional level of *MIDDLE EAST, AFRICA, EUROPE, ASIA* and *AMERICA*.

There isn't much solid empirical evidence that Judaism, Christianity or Islam exerted a unique impact on the length of reign of historical civilizations. What seems to have been important was adherence to one of the three monotheistic traditions and not to Judaism, Christianity or Islam in particular. This effect of monotheism on the stability of civilizations is also quite robust: changing the empirical specification, including or excluding some other variables, such as the specific decades of existence, region of influence, location of capital, the number of total civilizations in the region, whether Judaism, Christianity or Islam was yet born, etc., does not eliminate the impact of monotheism on endurance.

What about the effect of adherence to monotheism on geographic size? In order to find out, we can run regressions similar to those in equation (A.2.1):

$$\begin{aligned} Peak\ Land\ Mass_i &= \lambda_0 + \lambda_1 Monotheist_i + \lambda_2 Monotheist_i * Birth\ Year_i \\ &\quad + \lambda_3 Other\ Controls_i + \varepsilon_i \end{aligned} \tag{A.2..3}$$

**Table A.2.3:** Cross-Section Estimates, 2900 BCE - 1750 CE

Dependent Variable: Peak Land Mass

| | OLS | | | Robust Regressions | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *Monotheist* | 3.15 | 2.13 | 2.59 | .387 | .128 | .437 |
| | (2.80) | (2.54) | (2.54) | (.513) | (.520) | (.548) |
| *Monoth. * Birth Yr.* | −.0010 | −.00071 | −.00082 | −.00007 | .000002 | −.00007 |
| | (.0008) | (.00092) | (.00074) | (.00013) | (.00013) | (.00014) |
| *Middle East* | 1.84* | 1.98* | 1.93* | .031 | .065 | .075 |
| | (.395) | (.408) | (.450) | (.137) | (.137) | (.141) |
| *Africa* | .841* | 1.01* | .959* | .378* | .410* | .393* |
| | (.345) | (.357) | (.393) | (.146) | (.146) | (.150) |
| *Europe* | .692* | .848* | .798* | −.053 | −.012 | −.020 |
| | (.301) | (.290) | (.325) | (.128) | (.128) | (.132) |
| *Asia* | 2.39* | 2.42* | 2.38 | .345* | .367* | .359* |
| | (.119) | (.108) | (.143) | (.120) | (.119) | (.122) |
| *America* | −.910 | −.596 | −.812 | .469* | .557* | .435* |
| | (.630) | (.623) | (.506) | (.170) | (.172) | (.199) |
| *Birth Year* | .0004** | .00007 | .00009 | −.00008** | −.00019* | −.00011 |
| | (.0002) | (.00018) | (.00038) | (.00004) | (.00006) | (.00009) |
| *Birth of Judaism* | ... | 1.29** | 1.35** | ... | .299* | .436* |
| | | (.557) | (.673) | | (.138) | (.149) |
| *Birth of Christ.* | ... | ... | −.490 | ... | ... | −.370* |
| | | | (.659) | | | (.137) |
| *Birth of Islam* | ... | ... | .019 | ... | ... | .050 |
| | | | (.312) | | | (.116) |
| *No. of obs.* | 277 | 277 | 277 | 277 | 277 | 277 |
| $R^2$ | .093 | .101 | .102 | ... | ... | ... |

Note: * and ** respectively denote significance at the 5 percent and 10 percent levels. Cols. (1) - (6) dependent variable: peak land mass of civilization $i$ from its foundation to disintegration or termination (in years). Cols. (1) - (3): OLS estimates with errors clustered at the geographic region level. Cols. (4) - (6): robust regression estimates. In columns (1) through (3), all errors clustered at the regional level of *MIDDLE EAST, AFRICA, EUROPE, ASIA* and *AMERICA*.

In the table above, we present our key results where the dependent variable is the land mass (in square kilometers) of each civilization at its imperial or political peak.

As shown in all columns and in contrast with those in Table A.2.1, we do not find that the theistic attribute of the society had a positive impact on peak land mass. But we see that the birth of monotheism in the early-7th century BCE provides a common structural break in the peak land mass attained by civilizations historically. Taking the lower estimates provided in the robust regression columns of (4) and (6), we see that societies which were founded after 606 BCE had about 380,000 $km^2$ or roughly 25 percent larger land mass. In all of the estimates, having been in Africa exerts is positive and significant effect. But being on the American continent also provided a territorial advantage, as shown by the estimates involving *America* in the final three columns and despite the fact that there were many small sovereign establishments on that continent, such as the Mochica, Chavin and Chimu. Still, the strongest positive and significant geographic effect was being in *Asia*: whereas on average societies in the dataset attained about 1.5 million $km^2$, all else equal, being in Asia generated a size of about 4 million $km^2$, which is about a 170 percent impact.

In columns (2) and (5), we control for the births of Christianity and Islam to see if they could provide additional explanatory power. With the robust regression estimate in column (5), we find that the birth of Christianity might have had an adverse statistically significant effect on peak land mass, but not enough to offset the positive and significant impact of the birth of monotheism (read: Judaism).

For a fuller treatment of this topic and further details on the technical material related to this chapter, please see Iyigun (2010).

# 2 Chapter 4 Appendix

## 2.1 A Theory of Religious Identity, Conflict and Cooperation

### 2.1.1 Endowments and Technologies

Consider three countries at time zero when each country $i$, $i$ =**A**, **B**, **C**, is endowed with an identical amount of $z$. The intra-temporal output of country $i$ in period $t$, $y_t^i$, is produced using its endowment input $z^i$ net of lump-sum taxes $\tau_t^i$:

$$y_t^i = z^i - \tau_t^i \ . \tag{A.4.1}$$

Each country is ruled by a sovereign who has an infinite time horizon. In every period $t$, this sovereign has the power to tax his country's endowment base $z$ to raise revenue and use it to contest the ownership of the endowments of another country via military action or defend his territory against hostility from others.

If a country declares war on another, both countries' endowments becomes contestable. Country $i$ wins the war with probability $p_t^{ij}$ and country $j$ wins it with probability $1-p_t^{ij} \equiv p_t^{ji}$. The victorious country claims all of the contested endowments $2z$ as its own.

Military power depends on the military technology parameters $\beta^i$, $i$ =**A**, **B**, **C**, and the total amount of resources devoted to military spending. In turn, the relative strength of the militaries decides the expected likelihood of winning a war. That is, if countries $i$ and $j$ confront each other in period $t$, then the probability of $i$ winning the conflict is

$$p_t^{ij} = \frac{\beta^i \tau_t^i}{\beta^i \tau_t^i + \beta^j \tau_{jt}} \tag{A.4.2}$$

where $i$, $j$ =**A**, **B**, **C**, $i \neq j$, and $\beta^i$, $\beta^j > 0$, representing the potency of country $i$ and $j$'s military strengths. Increases in $i$'s military strength through higher military spending $\tau_t^i$ raise the likelihood that country $i$ wins the military conflict, and increases in $j$'s military strength lowers the likelihood that country $i$ can claim victory. For expositional simplicity, I assume $\beta^A \equiv 1$.

Besides other factors, the $\beta$'s are functions of whether or not two military foes subscribe to the same faith. In particular, implicit in our discussion is the notion that when two countries adhere to two different religions, their $\beta$'s are higher in conflict. As well, this notion can apply within religious faiths—albeit with less intensity and fervor—to the extent that two potential rivals share a common religion but subscribe to two different sects within it.

The sovereign in country $i$ maximizes his country's net expected discounted output over time:

$$\max_{\tau_t^{ij}} \sum_{t=0}^{\infty} \delta^t p_t^{ij} (Z_t - \tau_t^i) \tag{A.4.3}$$

where $\delta$, $0 < \delta < 1$, represents the sovereigns' time discount factor, $Z_t \in \{z, 2z, 3z\}$ denotes the endowment base of country $i$ at time $t$, and where, in every period $t$, the state budget needs to be balanced:

$$\tau_t^i \leq Z_t . \tag{A.4.4}$$

### 2.1.2 Three Cases

Given the geographical alignments of the three countries and the limitations of military technology expressed above, there are three equilibria we need to investigate: In one, Country **A** and **B** engage in a military conflict, while Country **C** finds it in its interest not to interfere. Then, depending on the outcome of that conflict, Country **C** engages either Country **A** or **B** subsequently. At the end of two periods, there will be one country left standing with all the resources at its disposal thereafter. Recall that Figures A.4.2 and A.4.3 above depict this case under the assumption that Country **A** prevails over **B** in the first period.

In a second scenario, Country **B** and **C** engage in a military conflict at the outset, while Country **A** sits on the sideline. In the following period, Country **A** confronts the winner of the war between Country **B** and **C**.

In the third and final scenario, peace prevails indefinitely although this does not imply that no country chooses to arm militarily.

In what follows, I will ignore two other potentially relevant equilibria in which two countries form a coalition against the remaining country and engage it militarily at time zero (i.e., Country **A** and **B** collude against Country **C** or Country **B** and **C** join forces against Country **A**). Such collaborations require commitment between colluding countries which is typically hard if not impossible to enforce. The commitment problem arises because it would be in the interest of the stronger partner of any alliance to renege on its promise not to attack its weaker collaborator after their joint foe is defeated or, at the very least, disregard the agreed upon division of the spoils of victory. This problem could be overcome only if the stronger agent can ex ante commit to an agreement which would be in effect after the enemy if defeated.

Returning back to the three cases that we shall investigate:

**(a)** Working our way backward, we begin at $t = 1$ when Country **C** takes on the winner of the conflict between **A** and **B**. Let $v$, $v =$ **A**, **B**, represent the victor of the first conflict at $t = 0$. At $t = 1$, countries **C** and $v$ respectively solve the following problems:

$$\max_{\tau_1^C} \left( z - \tau_1^C \; + \; 3zp_1^{Cv} \sum_{t=2}^{\infty} \delta^{t-1} \right) \tag{A.4.5}$$

and

$$\max_{\tau_1^v} \left( 2z - \tau_1^v \; + \; 3z(1 - p_1^{Cv}) \sum_{t=2}^{\infty} \delta^{t-1} \right) \tag{A.4.6}$$

subject to equations (A.4.1), (A.4.2) and (A.4.4).

According to (A.4.5) and (A.4.6), country **C** enters $t = 1$ with an endowment of $z$ because it has not engaged in conflict at $t = 0$, whereas country $v$ begins $t = 1$ with an endowment of $2z$ because it has captured the endowment of its rival at $t = 0$. For Country **C**, the expected likelihood of winning its conflict with $v$ equals $p_1^{Cv}$, and for $v$, that likelihood is equal to $1 - p_1^{Cv}$. Whichever country wins the war at $t = 1$ claims all of the endowments, $3z$, and ensure not to face a rival at any future date $t > 2$.

In all that follows, I assume that the free parameter values are such that we get interior solutions. With that, equations (A.4.5) and (A.4.6) yield $\tau_1^C = \tau_1^v \equiv \bar{\tau}_1$ where

$$\bar{\tau}_1 = \frac{\beta^C \beta^v}{(\beta^C + \beta^v)^2} 3\Delta z \; ; \qquad \Delta \equiv \frac{\delta}{1 - \delta} \; . \tag{A.4.7}$$

The optimal amount of resources allocated to military buildup are identical for the two countries; it rises with the total endowment base, $3z$, and the combined military strengths, $\beta^3$ and $\beta^v$.

On the basis of (A.4.7), we can express the net expected value of scenario (a) to countries **C** and $v$ at time 1 respectively as follows:

$$V_1^C = \left[1 + \left(\frac{\beta^C}{\beta^C + \beta^v}\right)^2 3\Delta\right] z \tag{A.4.8}$$

and

$$V_1^v = \left[2 + \left(\frac{\beta^v}{\beta^C + \beta^v}\right)^2 3\Delta\right] z \ . \tag{A.4.9}$$

According (A.4.8), the expected value to Country **C** of remaining at peace in period zero and then engaging in period one the country that emerges victorious in its conflict at time zero is an increasing function of its endowment base $z$ as well as its military conflict technology $\beta^C$, but it is a decreasing function of the potency of the military technology of its rival $\beta^v$. In analogous fashion, (A.4.9) suggests that the expected value to country $v$ of engaging its neighbor first and Country **C** next rises with $z$ and $\beta^v$ whereas it falls with $\beta^C$.

Now consider the choices made by the sovereigns of Country **A** and **B** in period 0:

$$\max_{\tau_0^i} \ \left(z - \tau_0^i \ + \ \delta p_0^{ij} V_1^i\right) \tag{A.4.10}$$

subject to equations (A.4.1), (A.4.2), (A.4.4), (A.4.9) and where $i$, $j$ = **A**, **B**, $i \neq j$.

Solving the problem in (A.4.10) for both $i$ and $j$ yields $\bar{\tau}_0^B = \Omega \bar{\tau}_0^A$ where

$$\Omega \equiv \left[2 + \left(\frac{\beta^B}{\beta^B + \beta^C}\right)^2 3\Delta\right] \Bigg/ \left[2 + \left(\frac{1}{1 + \beta^C}\right)^2 3\Delta\right] > 1 \ . \tag{A.4.11}$$

As a result, we get

$$\bar{\tau}_0^A = \frac{\delta \beta^2 \Omega z}{(1 + \beta^B \Omega)^2} \left[2 + \left(\frac{1}{1 + \beta^C}\right)^2 3\Delta\right] \ , \tag{A.4.12}$$

and

$$\bar{\tau}_0^B = \frac{\delta \beta^2 \Omega z}{(1 + \beta^2 \Omega)^2} \left[2 + \left(\frac{\beta^B}{\beta^B + \beta^C}\right)^2 3\Delta\right] \ . \tag{A.4.13}$$

On the basis of (A.4.12) and (A.4.13), we can express the net expected value of scenario (a) to Country **A** and **B** at time 0 respectively as

$$ {}^{a}V_0^A = \left\{ 1 + \delta \left( \frac{1}{1+\beta^B\Omega} \right)^2 \left[ 2 + \left( \frac{1}{1+\beta^C} \right)^2 3\Delta \right] \right\} z \tag{A.4.14} $$

and

$$ {}^{a}V_0^B = \left\{ 1 + \delta \left( \frac{\beta^B\Omega}{1+\beta^B\Omega} \right) \left( \frac{(\beta^B-1)\Omega+1}{1+\beta^B\Omega} \right) \left[ 2 + \left( \frac{\beta^B}{\beta^B+\beta^C} \right)^2 3\Delta \right] \right\} z \tag{A.4.15} $$

In terms of notation, note that the lowercase superscript $a$ to the left of the value function, $V$, denotes the latter under case (a). (A.4.14) and (A.4.15) have some of the same properties of (A.4.8) and (A.4.9): increases in the endowment base $z$ raise them and countries' own military potencies do too, but increases in their opponents' military might reduces both (A.4.14) and (A.4.15). What is different, however, is that all three countries' military technology parameters, $\beta$s, have a bearing on (A.4.14) and (A.4.15) but not on (A.4.8) and (A.4.9). At time one, the expected values are expressed conditional on survival in period zero, when both Country **A** and **B** face the prospect of fighting two wars back to back. Their appraisal of the future implicitly reflects surviving both those challenges, which in turn depend on the military technologies of all three players.

For this equilibrium to be stable, Country **C** ought to find it optimal to decide not to attack Country **B** at $t = 0$. Moreover, if Country **B** would have to engage **A** at the outset and its optimal for Country **C** to delay an attack on **B**, then it would be optimal for $i = \mathbf{C}$ not to invest any resources to its military.

Using equation (A.4.8), we can derive the expected value to Country **C** of remaining idle at $t = 0$ as

$$ {}^{a}V_0^C = \left\{ 1 + \delta + 3\delta\Delta \left[ \left( \frac{1}{1+\beta^B\Omega} \right) \left( \frac{\beta^C}{1+\beta^C} \right)^2 + \left( \frac{\beta^B\Omega}{1+\beta^B\Omega} \right) \left( \frac{\beta^C}{\beta^B+\beta^C} \right)^2 \right] \right\} z \tag{A.4.16} $$

By comparing (A.4.16) with the expected value to $i = \mathbf{C}$ of engaging $i = \mathbf{B}$ immediately, we can determine whether or not case (a) is sustainable as an equilibrium. To that end, consider this:

$$\frac{\partial(^{a}V_0^C)}{\partial\beta^B} = -\left\{ \begin{array}{c} \frac{\Omega}{(1+\beta^B\Omega)^2}\left[\left(\frac{\beta^C}{1+\beta^C}\right)^2 - \left(\frac{\beta^C}{\beta^B+\beta^C}\right)^2\right] \\ \\ +\left(\frac{2\beta^B\Omega}{1+\beta^B\Omega}\right)\frac{\beta^C}{(\beta^B+\beta^C)^3} \end{array} \right\} 3\delta\Delta z < 0, \qquad \text{(A.4.17)}$$

Equation (A.4.17) is strictly negative because both terms in the curvy brackets are strictly positive. This shows that the expected value to Country **C** of not being at war at time zero declines as the military effectiveness of its future opponents rises.

Nonetheless, we cannot conclude on this basis that scenario (a) is less sustainable when either Country **A** or **B** is militarily very superior to Country **C**. Quite the contrary: as we shall establish below, as those countries become more powerful militarily, it will be in the interest of Country **C** to defer a confrontation with either opponent because, by doing so, it will be able to ensure survival in period zero and face only one formidable opponent at time one. In other words, while equation (A.4.16) declines with increases in $\beta^B$, we shall demonstrate that the negative impact of an increase in $\beta^B$ on the expected value at time zero of Country **C** engaging Country **B** in period zero will be even larger. We address this scenario next.

**(b)** Country **B** and **C** engage in military conflict at $t = 0$ and the winner takes on Country **A** at $t = 1$. This case is identical to the previous one with the exception of Country **B** confronting Country **C** immediately instead of Country **A**.

$$\bar{\tau}_1 = \frac{\beta^v}{(1+\beta^v)^2} 3\Delta z \; ; \qquad v = \mathbf{B},\ \mathbf{C}\ . \qquad \text{(A.4.18)}$$

The expected net value of scenario (b) to countries **A** and $v$ at time 1 respectively are

$$V_1^A = \left[1 + \left(\frac{1}{1+\beta^v}\right)^2 3\Delta\right] z \qquad \text{(A.4.19)}$$

and

$$V_1^v = \left[2 + \left(\frac{\beta^v}{\beta^C+\beta^v}\right)^2 3\Delta\right] z\ . \qquad \text{(A.4.20)}$$

Equations (A.4.19) and (A.4.20) are analogous to equations (A.4.8) and (A.4.9) respectively: the expected value to Country **A** of engaging the survivor of the conflict between Country **B** and **C** at time one rises with $z$ but it falls with $\beta^v$, $v$ = **B**, **C**. And the same properties hold for whichever of the two countries emerges victorious to face Country **A** in period one.

At time 0, when Country **B** and **C** face each other in conflict, we get $\bar{\tau}_0^C = \Omega\bar{\tau}_0^B$ where

$$\Psi \equiv \left[2 + \left(\frac{\beta^C}{1+\beta^C}\right)^2 3\Delta\right] \Bigg/ \left[2 + \left(\frac{\beta^B}{1+\beta^B}\right)^2 3\Delta\right] > 1 \; . \qquad \text{(A.4.21)}$$

Thus, we have

$$\bar{\tau}_0^B = \frac{\delta z \beta^B \beta^C \Psi}{(\beta^B + \beta^C \Psi)^2} \left[2 + \left(\frac{\beta^B}{1+\beta^B}\right)^2 3\Delta\right] \; , \qquad \text{(A.4.22)}$$

and

$$\bar{\tau}_0^C = \frac{\delta z \beta^B \Psi}{(1 + \beta^B \Psi)^2} \left[2 + \left(\frac{\beta^C}{1+\beta^C}\right)^2 3\Delta\right] \; . \qquad \text{(A.4.23)}$$

With (A.4.22) and (A.4.23), we can express the expected net values of scenario (b) to Country **B** and **C** at time 0 respectively as

$${}^bV_0^B = \left\{1 + \delta \left(\frac{\beta^B}{\beta^B + \beta^C \Psi}\right)^2 \left[2 + \left(\frac{\beta^B}{1+\beta^B}\right)^2 3\Delta\right]\right\} z \qquad \text{(A.4.24)}$$

and

$${}^bV_0^C = \left\{1 + \delta \left(\frac{\beta^C \Psi}{\beta^B + \beta^C \Psi}\right) \left(\frac{(\beta^C - \beta^B)\Psi + 1}{\beta^B + \beta^C \Psi}\right) \left[2 + \left(\frac{\beta^C}{1+\beta^C}\right)^2 3\Delta\right]\right\} z \qquad \text{(A.4.25)}$$

In line with the notation we adopted in case (a), the lowercase superscript $b$ to the left of the value function, $V$, now denotes the latter under case (b).For this equilibrium to be stable, Country **A** ought to find it optimal to decide not to attack Country **B** at $t = 0$. Since Country **B** and **C** are engaged in conflict at that time, Country **A** would find it optimal not to invest in its military at $t = 0$. Hence, the analog of (A.4.16) in this case is

$$ {}^{b}V_0^A = \left\{ 1 + \delta + \left[ \left( \frac{\beta^B}{\beta^B + \beta^C \Psi} \right) \left( \frac{1}{1+\beta^B} \right)^2 + \left( \frac{\beta^C \Psi}{\beta^B + \beta^C \Psi} \right) \left( \frac{1}{1+\beta^C} \right)^2 \right] 3\Delta\delta \right\} z \tag{A.4.26} $$

Note that

$$ \frac{\partial({}^{b}V_0^C)}{\partial \beta^B} = -\frac{(1 + \beta^C \Psi + \beta^C \Psi)}{(\beta^B + \beta^C \Psi)^3} \left[ 2 + \left( \frac{\beta^C}{1+\beta^C} \right)^2 3\Delta \right] \delta z < 0, \tag{A.4.27} $$

which exceeds (A.4.17) in absolute value. Hence, the negative impact of an increase in $\beta^B$ on the expected value at time zero of Country **C** is larger if the latter is engaged in conflict with Country **B** in that period zero. And, as an extension, it is larger when, provided that it survives its confrontation with Country **B** in period zero, Country **C** would have to engage country **A** in military conflict in the next period.

**(c)** Finally, consider the scenario in which peace prevails indefinitely. It is not possible for all parties to invest no resources in military activities and for the peaceful equilibrium to be sustained because, in that case, one country could divert an infinitesimally small amount of resources to its military effort and invade and conquer its neighbor(s) without any resistance. Thus, peace can prevail as an equilibrium only if all countries allocate resources to military activities and neither chooses to attack its neighbor(s), similar in spirit to the non-appropriative equilibria with defensive fortifications described in Grossman and Kim (1995).

Consider the problem of Country **A** at $t = 0$. If country **A** arms in anticipation of engaging Country **B**, it will set its taxes at a level given by (A.4.12). Then, if Country **A** delays military action against **B** indefinitely, its indirectly utility will be given by

$$ {}^{c}V_0^A = \frac{z}{1-\delta} \left\{ 1 - \frac{\delta \beta^B \Omega}{(1+\beta^B \Omega)^2} \left[ 2 + \left( \frac{1}{1+\beta^C} \right)^2 3\Delta \right] \right\} . \tag{A.4.28} $$

A similar argument holds for Country **B** at $t = 0$, which yields:

$$ {}^{c}V_0^B = \frac{z}{1-\delta}\left\{1 - \frac{\delta\beta^B\Omega}{(\beta^B + \beta^C\Omega)^2}\left[2 + \left(\frac{\beta^B}{\beta^B+\beta^C}\right)^2 3\Delta\right]\right\} . \tag{A.4.29} $$

Country **C**, in contrast, would be getting $z$ ad infinitum, yielding an expected value of scenario (c) to it given by

$$ {}^{c}V_0^C = \frac{z}{1-\delta} . \tag{A.4.30} $$

Scenario (c) could also apply if Country **A** stays on the sidelines, Country **B** and **C** arm to confront each other at time zero, but they delay military action indefinitely. In this case, we will get the following expected values for the three players:

$$ {}^{c}\hat{V}_0^A = \frac{z}{1-\delta} . \tag{A.4.28'} $$

A similar argument holds for Country **B** at $t = 0$:

$$ {}^{c}\hat{V}_0^B = \frac{z}{1-\delta}\left\{1 - \frac{\delta\beta^B\beta^C\Psi}{(\beta^B + \beta^C\Psi)^2}\left[2 + \left(\frac{\beta^B}{1+\beta^B}\right)^2 3\Delta\right]\right\} . \tag{A.4.29'} $$

Country **C**, in contrast, would be getting $z$ ad infinitum, yielding an expected value of scenario (c) to it given by

$$ {}^{c}\hat{V}_0^C = \frac{z}{1-\delta}\left\{1 - \frac{\delta\beta^B\beta^C\Psi}{(\beta^B + \beta^C\Psi)^2}\left[2 + \left(\frac{\beta^C}{1+\beta^C}\right)^2 3\Delta\right]\right\} . \tag{A.4.30'} $$

### 2.1.3 Sustainable Equilibria

We are now in position to assess which of the three equilibria could be sustained depending on parameter values. To start with, it is straightforward to establish that with sufficiently forward-looking rulers, for whom the discount factor $\delta$ is closer to one, case (c) yields the highest indirect utility. However, if the discount factor is relatively low, then either case (a) or case (b) would prevail over peace.

When this is the case, we will need to verify that a solution does exist; as I alluded to in the discussions of cases (a) and (b), it is possible that neither scenario is sustainable if it is not optimal for countries not in conflict in the first period to await the victor of an earlier conflict.

Keep in mind that Country **B** is in a precarious and unenviable position. If it comes under attack by either Country **A** or **C**, it has no choice but to engage in military conflict to defend itself. And for Country **B** to avoid a military conflict, both countries **A** and **C** need to find it in their interest to refrain from attacking Country **B**. Countries **A** and **C**, by contrast, are slightly better off because, as long as Country **B** does not initiate conflict, they can decide for themselves whether or not to engage Country **B** militarily.

Recalling that $\beta^A \equiv 1$, consider next the case in which Country **B** and **C** are evenly matched, i.e., $\beta^B = \beta^C > 1$. Under such parameter restrictions and substituting $\beta^B$ for $\beta^C$ in (A.4.16), (A.4.15) and (A.4.16) become

$$ {}^{a}V_0^2 = \left\{ 1 + \delta \left( \frac{\beta^2}{1+\beta^2} \right) \left( \frac{(\beta^2 - 1)\Omega + 1}{1 + \beta^2 \Omega} \right) \left( 2 + \frac{3\Delta}{4} \right) \right\} z \tag{A.4.31} $$

and

$$ {}^{a}V_0^3 = \left\{ 1 + \delta + \left[ \left( \frac{1}{1+\beta^2\Omega} \right) \left( \frac{\beta^2}{1+\beta^2} \right)^2 + \frac{1}{4} \left( \frac{\beta^2 \Omega}{1+\beta^2\Omega} \right) \right] 3\Delta\delta \right\} z \tag{A.4.32} $$

And equations (A.4.25) and (A.4.26) simplify to

$$ {}^{b}V_0^2 = \left\{ 1 + \frac{\delta}{2} + \frac{3\Delta\delta}{4} \left( \frac{\beta^2}{1+\beta^2} \right)^2 \right\} z \tag{A.4.33} $$

and

$$ {}^{b}V_0^3 = \left\{ 1 + \frac{\delta}{2} + \frac{3\Delta\delta}{4} \left( \frac{\beta^2}{1+\beta^2} \right)^2 \right\} z \ . \tag{A.4.34} $$

It is straightforward to verify that, $\forall \ \beta^2 = \beta^3 > 1$, equation (A.4.32) exceeds (A.4.34). Thus, Country **C** will prefer to defer a confrontation early on. Moreover, $\exists \ \beta^2 = \beta^3 > 1$ such that (A.4.31) is greater than (A.4.33) and Country **B** prefers to engage Country **A** immediately.

Here is the reason why: Equation (A.4.32) evaluated at $\beta^2 \to 1$ equals 1 + $\delta$ + $3\delta\Delta/4$ and (A.4.34) evaluated at $\beta^2 \to 1$ equals 1 + $\delta/2$ + $3\delta\Delta/16$. Hence, in the limit when $\beta^2 \to 1$, (A.4.32) strictly exceeds (A.4.34). Equation (A.4.32) evaluated at $\beta^2 \to \infty$ equals 1 + $\delta$ + $3\delta\Delta/4$ and (A.4.34) evaluated at $\beta^2 \to \infty$ equals 1 + $\delta/2$ + $3\delta\Delta/4$ . As a result, in the limit when $\beta^2 \to \infty$, (A.4.32) strictly exceeds (A.4.34). Note that the net expected values of scenarios (a) and (b), ${}^aV_0^2$, ${}^aV_0^3$, ${}^bV_0^2$, ${}^bV_0^3$, are strictly monotonic in $\beta^2$. This establishes that, $\forall$ $\beta^2 = \beta^3 > 1$, ${}^aV_0^3 > {}^bV_0^3$.

In similar fashion, we can evaluate equation (A.4.31) at $\beta^2 \to 1$ and get 1 + $\delta/2$ + $3\delta\Delta/16$. And we can evaluate (A.4.33) at $\beta^2 \to 1$ to generate 1 + $\delta/2$ + $3\delta\Delta/16$. Equation (A.4.31) evaluated at $\beta^2 \to \infty$ yields 1 + $2\delta$ + $3\delta\Delta/4$ and (A.4.33) evaluated at the same point generates 1 + $\delta/2$ + $3\delta\Delta$/A.4. Given that the net expected values of scenarios (a) and (b), ${}^aV_0^2$, ${}^aV_0^3$, ${}^bV_0^2$, ${}^bV_0^3$, are strictly monotonic in $\beta^2$, it follows that $\forall$ $\beta^2 = \beta^3 \in [1, \infty]$, (A.4.31) exceeds (A.4.33). That is, ${}^aV_0^2 > {}^bV_0^2$

Given these findings, we conclude that, $\forall$ $\beta^2 = \beta^3 > 1$ case (a) will be the stable equilibrium.

Next consider parameter values $\beta^3 > \beta^2 = 1$ such that Country **C** dominates the other two countries in military technology. Rewriting (A.4.14) under the assumption that $\beta^2 = 1$, we get

$$ {}^aV_0^1 = \left\{ 1 + \frac{\delta}{2} + \frac{3\Delta\delta}{4} \left( \frac{1}{1+\beta^3} \right)^2 + \right\} z \tag{A.4.35} $$

And rewriting (A.4.16) with $\beta^2 = 1$ yields

$$ {}^aV_0^3 = \left\{ 1 + \delta + \frac{3\Delta\delta}{4} \left( \frac{\beta^3}{1+\beta^3} \right)^2 + \right\} z \tag{A.4.36} $$

Going through the same steps with equations (A.4.24) and (A.4.25), we generate

$$ {}^bV_0^1 = \left\{ 1 + \delta + \left[ \frac{1}{4} \left( \frac{1}{1+\beta^3\Omega} \right) + \left( \frac{\beta^3\Omega}{\beta^2+\beta^3\Omega} \right) \left( \frac{1}{1+\beta^3\Omega} \right)^2 \right] 3\Delta\delta \right\} z \tag{A.4.37} $$

$$ {}^{b}V_0^3 = \left\{ 1 + \frac{\delta}{2} \left( \frac{(\beta^3 - 1)\Omega + 1}{1 + \beta^3 \Omega} \right) \left[ 2 + \left( \frac{\beta^3}{1 + \beta^3} \right)^2 \right] 3\Delta \right\} z \ . \tag{A.4.38} $$

It is straightforward to verify that, $\forall\ \beta^3 = 1$, equation (A.4.37) exceeds (A.4.35). Thus, Country **A** will prefer not to engage Country **B** in the first period. In contrast, Country **C** will want to engage Country **B** in the first period if $\beta^3$ is sufficiently large because, $\exists\ \beta^3 > 1$ such that (A.4.38) is greater than (A.4.36).

To demonstrate that this is the case, we can proceed as we did above: Equation (A.4.35) evaluated at $\beta^3 \to 1$ equals $1 + \delta/2 + 3\delta\Delta/16$ and (A.4.37) evaluated at $\beta^3 \to 1$ equals $1 + \delta + 3\delta\Delta/\text{A.4}$. Equation (A.4.35) evaluated at $\beta^3 \to \infty$ equals $1 + \delta/2$ and (A.4.37) evaluated at $\beta^3 \to \infty$ equals $1 + \delta$. Again, due to the fact that the expected payoffs ${}^{a}V_0^1$, ${}^{1}V_0^3$, ${}^{b}V_0^1$, ${}^{b}V_0^3$ are strictly monotonic in $\beta^3$, we can conclude that, $\forall\ \beta^3 \in [1, \infty] \wedge \beta^3 > \beta^2 = 1$, ${}^{b}V_0^1 > {}^{a}V_0^1$.

Now take equations (A.4.36) and (A.4.38): (A.4.36) evaluated at $\beta^3 \to 1$ yields $1 + \delta + 3\delta\Delta/16$ and (A.4.38) evaluated at the same point generates $1 + \delta/2 + 3\delta\Delta/16$. Equation (A.4.36) evaluated at $\beta^3 \to \infty$ yields $1 + \delta + 3\delta\Delta/4$ and (A.4.38) evaluated at the same point generates $1 + \delta + 3\delta\Delta/2$. Given that ${}^{a}V_0^1$, ${}^{a}V_0^3$, ${}^{b}V_0^1$ and ${}^{b}V_0^3$ are strictly monotonic in $\beta^3$, it follows that $\exists\ \beta^3 \in (1, \infty)$ for which (A.4.38) exceeds (A.4.36).

Thus, we conclude that, $\exists\ \beta^3 > \beta^2 = 1$, case (b) will be the stable equilibrium.

In terms of the advent of Abrahamic monotheisms, one can think of the role of religious differences and affinities as coming to bear on the $\beta$'s in this model. Specifically and in line with Chapters 2 and 3 as well as the discussion in Section A.4.2 above, we can conjecture that a monotheist country bordering one with a non-monotheist religious creed was tantamount to the former having a considerably higher $\beta$ vis-a-vis the latter. We have already established above that such a scenario would make the monotheist country allocate relatively more of its resources to its military, as a result of which its likelihood of triumphing over its neighbor in a confrontation would be relatively higher.

By contrast, two bordering countries with their majorities subscribing to different monotheisms defines a situation analogous to both countries having relatively high $\beta$'s. We have already seen that such countries would allocate relatively more resources to military conflict, although their likelihood of prevailing over their monotheistic adversaries would not be that much higher because both countries would have similar $\beta$'s.

# 3 Chapter 6 Appendix

## 3.1 Ottoman Wars and intra-European Violence

We obtain the impact of Ottoman military activities on regional conflicts in continental Europe by estimating the following equation:

$$\begin{aligned} \textit{European Conflicts}_t \quad = \quad & \lambda_0 + \lambda_1 \textit{Ottoman's European Conflicts}_t + \lambda_2 \ \textit{Year} \\ & + \lambda_3 \textit{Year*Ottoman's European Conflicts}_t \\ & + \lambda_4 \textit{Ottoman's non-European Conflicts}_t \\ & + \lambda_5 \textit{Year*Ottoman's non-European Conflicts}_t \\ & + \lambda_6 \textit{Other Controls}_t + \varepsilon_t, \qquad \text{(A.6.1)} \end{aligned}$$

where our key dependent variable will be one of three alternative dependent variables described below; *Ottoman's European Conflicts* is the number of conflicts in which the Ottoman Empire confronted European powers at time $t$; *Ottoman's non-European Conflicts* is the count at time $t$ of the newly-initiated number of Ottoman conflicts outside Europe as well as its own domestic civil discords.

In various alternative empirical specifications, the dependent variable, *European Conflicts*, will be:

1. The number of violent conflicts initiated among or within continental European countries in the same year (as the variables on the right-hand side of equation (A.6.1)). This measure of intra-European confrontations does not distinguish whether these confrontations were between sovereigns, domestic uprisings against the sovereigns or related to civil wars. By definition, it also does not account for whether they involved a religious dimension either.

2. The aggregate number of intra-European conflicts, including those which began in the same period as well as those began earlier. This measure is broader than the first but can help us identify if the Ottomans' role in subduing intra-European violent confrontations were strong enough to even bring to halt existing feuds. Like the first measure of intra-European conflicts, however, this one too abstracts from the religious nature of the conflicts.

3. The conflicts of a religious nature between the Catholics and the Protestants began in the same year as the control variables. This definition is the narrowest and it includes the Schmalkaldic Wars in 1546 and 1547; the Thirty-Years War between 1618 and 1648; the French Wars of Religion between 1562 and 1598; the war between the Holy Roman Emperor and the Transylvanian Protestants between 1601 and 1604; the French Huguenot uprisings of 1621 and 1622; and the French Huguenot uprisings between 1625 and 1629. The advantage of this last measure is that it is narrowly defined as the religiously motivated wars involving the Protestants and the Catholics.

Regardless of the definition involved, the dependent variables are comprehensive: they include all Ottoman conflicts on record (including naval battles) with their rivals in Europe, the Middle East and North Africa. Classifying Ottoman confrontations by geographic region can be complicated because of the ambiguities of defining the border of the European continent vis-a-vis Asia (see, for example, Findlay and O'Rourke, 2007, p. 2). For practical purposes, I divide the Eurasian landmass roughly vertically with reference to Istanbul (the Ottoman capital), and consider Ottomans' involvements to the west of that division to be in Europe and to the east of it to be in Asia (hence, as elsewhere). Accordingly, Ottomans' various Crimean, Muscovy and Russian engagements are classified as Ottoman conflicts outside Europe, while those with and in Lithuania, Moldavia and Poland are categorized as Ottoman-European confrontations.

Let us start our investigation with our first dependent variable which is the count of violent confrontations in continental Europe initiated in any given year between 1451 and 1700. Table A.6.1 below is generated running six different Poisson regressions of the type shown in equation (A.6.1) and using our first definition of intra-European hostilities. The main results I report below rely on Poisson (negative binomial) regressions with robust errors, designed primarily for count data that are discreet and have a preponderance of zeros and small values.

The first three columns of Table A.61 show how Ottoman military activities every year between 1451 and 1700 influenced those that were newly initiated amongst and within the continental European countries. Column (1) presents the estimates from the most parsimonious specification. As shown, Ottoman military excursions in continental Europe had a statistically significant and negative impact on the number of European violent feuds. Moreover, the interaction of *Year* with *Ottomans' European Conflicts* is positive and statistically significant, implying that the impact of the Ottomans on intra-European feuds was waning over time. Still, the net effect of Ottoman military engagements in subduing intra-European conflicts was quite substantial in the late-15th and early-16th centuries: one additional Ottoman military engagement in Europe in 1500, for example, lowered the log of the number of intra-European conflicts by roughly .562. Given that the average number of intra-European violent confrontations was about 1.5 per annum, this implies that Ottoman military activities in continental Europe around the year 1500 reduced intra-European violent engagements by roughly 25 percent. According to the coefficient estimates in column (1), the negative impact of Ottomans on intra-European conflicts disappeared around the year 1593. Interestingly, this is roughly two decades following the first decisive defeat of the Ottomans in European hands at Lepanto.

In the following two columns we add different right-hand-side variables in the regressions, although our key finding remains intact: That is, the interaction of *Year* with *Ottomans' European Conflicts* is positive and statistically significant, indicating a waning impact over time of the Ottomans on intra-European feuds. Given the coefficients on *Ottomans' European Conflicts* and *Year * Ottomans' European Conflicts* in column (2), the influence of Ottomans on intra-European conflict begun to turn positive around the year 1578, seven years after the Lepanto Sea Battle.

In the last three columns of Table A.6.1, we repeat the above steps using our second alternative definition of intra-European conflicts which is newly-initiated as well as on-going intra-European feuds. All three estimates indicate that the Ottomans' role in subduing intra-European violent conflicts went beyond just suppressing new ones; it also had an influence on the propensity for Europeans to end their existing feuds. Since the average number of aggregate intra-European conflicts is 4.7 in the sample, the coefficient estimates in the last three columns suggest a reduction of roughly 20 to 25 percent around the turn of the 16th century.

**Table A.6.1:** Annual Data, 1450 CE – 1700 CE

Dependent Variable: No. of New Continental European Wars per Year, (1) - (3)
No. of All Continental European Wars per Year, (4) - (6)

| | Poisson Regressions | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Ottomans' Euro Conflicts$_t$ | $-.562^*$ | $-.497^*$ | $-.465^{**}$ | $-.293^*$ | $-.280^*$ | $-.178^{**}$ |
| | (.231) | (.221) | (.247) | (.095) | (.095) | (.108) |
| Ottomans' non-EU Conflicts$_t$ | .155 | .190 | .352 | $-.030$ | $-.017$ | .009 |
| | (.307) | (.294) | (.300) | (.110) | (.107) | (.113) |
| Year | $-.013$ | $-.014$ | $-.012$ | $-.0005$ | $-.0005$ | .0014 |
| | (.0087) | (.009) | (.008) | (.004) | (.004) | (.0044) |
| Year*Ottomans' EU Con.$_t$ | $.0029^*$ | $.0028^*$ | .0022 | $.0013^*$ | $.0014^*$ | .0012 |
| | (.0014) | (.0014) | (.0015) | (.0006) | (.0007) | (.0007) |
| Year*Ottomans' non-EU Con.$_t$ | $-.0003$ | .00005 | .0002 | .0004 | .0005 | .0005 |
| | (.0018) | (.0018) | (.002) | (.0007) | (.0007) | (.0007) |
| Intra-EU Conflicts$_{t-1}$ | $-.051$ | $-.051$ | $-.058$ | $.148^*$ | $.149^*$ | $.137^*$ |
| | (.046) | (.046) | (.047) | (.011) | (.011) | (.011) |
| EU Population$_t$ | .057 | $-.057$ | .012 | $-.004$ | $-.0044$ | $-.050^{**}$ |
| | (.046) | (.045) | (.046) | (.021) | (.0021) | (.026) |
| Ottoman Population$_t$ | ... | ... | $.042^*$ | ... | ... | $.052^*$ |
| | | | (.019) | | | (.009) |
| *No. of obs.* | 250 | 250 | 250 | 250 | 250 | 250 |
| *(pseudo)* $R^2$ | .022 | .024 | .036 | .151 | .151 | .166 |

Note: * and ** respectively denote significance at the 5 percent and 10 percent levels. Cols. (1) - (3) dependent variable: no. of conflicts that began in a given year with at least one continental European entity involved in each. Cols. (4) - (6) dependent variable: all new or on-going conflicts in a given year with at least one continental European group involved in each. Source for conflict data: Brecke (1999). Source for distance measures: http://www.geobytes.com/CityDistanceTool.htm. Source for population data: McEvedy and Jones (1978). Included in regressions (2), (3), (5) and (6) but not shown are the average durations of Ottomans conflicts in Europe and elsewhere. Included in columns (3) and (6) but also not shown are the average distance of Ottomans' conflicts from their capital, Istanbul as well as the total number of Ottomans' conflicts (ongoing as well as newly-initiated).

## 3.2 Ottomans & the Protestant Reformation

The third and final measure we can examine, in fact, is a pure count of the historically well-documented Protestant-Catholic confrontations. Table A.6.2 below shows results based on this narrowest definition of intra-European conflicts confined to those of a religiously-motivated nature.

What we see here is consistent with the hypothesis that the Protestant Reformation was aided and abated by the Ottomans' European aspirations: the number of Ottomans military engagements in Europe, for the most part, did exert a negative dampening impact on the number of Catholic-Protestant feuds. This impact tended to decline over time although, in any given year, an Ottomans military conquest in the Balkans or Eastern Europe reduced that number anywhere between roughly 25 percent and 40 percent.

**Table A.6.2:** European Wars of Religion Protestant-Catholic Confrontations

Dependent Variable: No. of Religious Wars per Year, 1451 to 1700, (1) - (3)
No. of Protestant-Catholic Wars per Year, 1521 to 1650, (4) - (6)

| | Poisson Regressions | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $OTTOMAN_t$ | $-.805^{**}$ | $-.782^{**}$ | .994 | $-1.46^{*}$ | $-1.25$ | $-1.25$ |
| | (.469) | (.475) | (.764) | (.759) | (.796) | (.778) |
| $OTHEROTTOMAN_t$ | $-.201$ | $-.132$ | $-.243$ | $-.432$ | $-.468$ | $-.274$ |
| | (.592) | (.574) | (.705) | (.811) | (.793) | (.781) |
| $TIME$ | $-.013$ | $-.0014$ | $-.015$ | .047 | .047 | .056 |
| | (.016) | (.0016) | (.015) | (.034) | (.034) | (.084) |
| $TIME^2$ | ... | ... | ... | $-.0001$ | $-.00012^{**}$ | $-.0001$ |
| | | | | (.00007) | (.0007) | (.0002) |
| $TIME * OTTOMAN_t$ | $.0046^{**}$ | $.0042^{**}$ | .0031 | $.0075^{*}$ | .0058 | .0057 |
| | (.0024) | (.0026) | (.0031) | (.0038) | (.0042) | (.0041) |
| $TIME * OTHEROT._t$ | .0017 | .0019 | .0019 | .0023 | .0026 | .0021 |
| | (.0030) | (.0030) | (.0035) | (.0041) | (.0039) | (.0039) |
| $PROTESTANT_{t-1}$ | $.961^{*}$ | $.957^{*}$ | $.847^{*}$ | $.914^{*}$ | $.892^{*}$ | $.702^{*}$ |
| | (.181) | (.180) | (.171) | (.154) | (.156) | (.179) |
| $EUROPEPOP_t$ | .074 | .079 | $-.076$ | $-.026$ | $-.013$ | .156 |
| | (.088) | (.087) | (.087) | (.049) | (.050) | (.112) |
| $OTTOPOP_t$ | ... | ... | $.178^{*}$ | ... | ... | $-.131$ |
| | | | (.026) | | | (.102) |
| No. of obs. | 250 | 250 | 250 | 130 | 130 | 130 |
| (*pseudo*) $R^2$ | .241 | .242 | .293 | .118 | .121 | .134 |

Note: * and ** respectively denote significance at the 5 percent and 10 percent levels. Cols. (1) - (3) dependent variable: no. of religiously-motivated conflicts that began in a given year within continental Europe between 1451 - 1700. Cols. (4) - (6) dependent variable: no. of Prot.-Cath. violent confrontations that began in a given year within continental Europe between 1521 - 1650. Source for conflict data: Brecke (1999). Source for distances: http://www.geobytes.com/CityDistanceTool.htm. Source for population data: McEvedy and Jones (1978). Included in regressions (2), (3), (5) and (6) but not shown are the average durations of Ottomans conflicts in Europe and elsewhere. Included in columns (3) and (6) but also not shown are the average distance of Ottomans' conflicts from their capital, Istanbul as well as the total number of Ottomans' conflicts (ongoing as well as newly-initiated).

For a more complete set of empirical analyses, please see Iyigun (2008).

# 4 Chapter 7 Appendix

## 4.1 Ottoman Harem Politics

We can tally up Ottoman wars by the reigns of the 31 sultans who ruled the empire between 1400 and 1909 and identify them by geographic region—that is, fought in the East against non-Europeans versus fought in the West mainly against the Christians. Then, we can obtain the impact of ethnic identities on Ottoman military conquests by estimating this equation:

$$\textit{Ottoman-European Wars}_i = \gamma_0 + \gamma_1 \textit{European Mom}_i + \gamma_2 \text{Other Controls}_i + \epsilon_i, \quad \text{(A.7.1)}$$

where *Ottoman-European Wars*$_i$ is number of newly-initiated conflicts between the Ottoman Empire and European powers during Sultan $i$'s reign and *European Mom*$_i$ is a dummy variable for whether sultan $i$ had a European maternal genealogical link.

If matrilineal genealogical links did matter for the Ottomans' conquest patterns, then we would expect $\gamma_1$ to be negative and statistically significant for specifications in which Ottomans' European military engagements are the dependent variables. As a corollary, we would expect $\gamma_1$ to be positive and statistically significant, or at least, insignificant, for specifications in which Ottomans' conflicts in the east and elsewhere are the dependent variables.

In the empirics below, the other control variables often include the length of reign of sultan $i$; the year of ascension of sultan $i$; estimates of the average Ottoman and European population levels during $i$'s sultanate; and an indicator variable for each of the three centuries during which sultan $i$ ruled. Depending on the parsimony of the empirical specification I employ and various alternative estimates, our other control variables are: the age at which the sultans ascended the throne; a dummy variable to denote whether $i$ ruled before or after the Lepanto Sea Battle in 1571; a dummy for whether or not the sultans' reign overlapped at all with his mother's tenure as Valide Sultan and the number of years during which the sultans' reign overlapped with his mother's tenure as Valide Sultan (i.e., when the queen mother was alive).

Consistent with our approach in the previous chapter, we include the year and century when the sultan began to rule in my estimates because there has been a secular decline in warfare in Europe since the 15th century. We will include the dummy for the year of the Lepanto war to examine if the Ottomans' patterns of military activity were altered following their first decisive defeat against European allied forces in 1571. We shall also control for the age at which the sultan ascended the throne as well as his length of reign to identify if those had systematic discernible effects on Ottoman military activities.

## 4.2 Main Results

Table A.7.1 summarizes our key findings based on equation (A.7.1). The dependent variable involves the total number of newly-initiated conflicts between the Ottomans and continental Europeans during the reign of a given sultan. The first regression is the most-parsimonious, univariate estimate. The indicator for a European matrilineal link comes in with the predicted negative sign and with a statistical significance at the five percent level. What is more telling is that the European matrilineal link dummy alone can explain more than 40 percent of the variation in Ottomans' European engagements. Even when the European matrilineal genealogy variable is added to the regressions last, the fit of the regressions, as measured by the $R^2$ measure, increases by at least four percentage points and at a maximum by more than 27 percent.

The next two regressions in columns (2) and (3) add three attributes of the reign of each sultan. Specifically, in column (2), we control for the reign of each sultan on account of the arithmetic that sultans that ruled longer might have engaged the Europeans more often. In column (3), we also include the year and century in which the sultan ascended his throne. In both regressions, the European matrilineal link dummy continues to enter with a negative and statistically significant coefficient, although its magnitude is roughly cut in half from the baseline regression in column (1).

Of the other explanatory variables considered, we see—without much surprise—that reign length does raise the likelihood of a European military engagement. But neither the year nor the century in which the sultan took the helm has any bearing on Ottoman's European confrontations. Column (4) then includes two demographic variables related to the Ottoman and European territories: the levels of population in continental Europe and territories under Ottoman control. The inclusion of these two controls does render the dummy for European matrilineal link statistically insignificant, although it still comes in with the right sign and registers a p-value of 19 percent. Column (5) incorporates three more variables related to the reign of sultans and their maternal links: the year in which the sultan took the throne, an indicator of whether the sultan's rule overlapped at all with his mother's life, and the number of years the sultan's rule and Valide Sultan's life overlapped. With this specification, we are back to a statistically significant and negative European matrilineal effect, with none of the controls besides the length of reign exerting an influence on Ottomans' European campaigns.

**Table A.7.1:** Cross-Sectional Results, 1400 CE – 1909 CE

Dependent Variable: No. of Ottoman-European Wars during Reign of Sultan

| | *OLS* Regressions | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $European\ Mom_i$ | $-7.06^*$ | $-3.50^*$ | $-3.25^{**}$ | $-2.67$ | $-2.91^{**}$ | $-2.52^{**}$ |
| | (2.20) | (1.66) | (1.73) | (2.00) | (1.59) | (1.35) |
| $Reign\ Length_i$ | ... | $.257^*$ | $.259^*$ | $.269^*$ | $.239^*$ | $.224^*$ |
| | | (.047) | (.050) | (.050) | (.071) | (.066) |
| $Ascension\ Year_i$ | ... | ... | .0039 | $-.0088$ | .025 | .043 |
| | | | (.015) | (.017) | (.031) | (.031) |
| $Ascension\ Century_i$ | ... | ... | $-.754$ | $-.852$ | $-2.22$ | $-2.70$ |
| | | | (1.57) | (1.62) | (2.06) | (2.07) |
| $Ottoman\ Population_i$ | ... | ... | ... | .083 | $-.155$ | .040 |
| | | | | (.129) | (.214) | (.209) |
| $European\ Population_i$ | ... | ... | ... | .023 | .001 | $-.011$ |
| | | | | (.013) | (.020) | (.019) |
| $Ascension\ Age_i$ | ... | ... | ... | ... | $-.137$ | $-.185$ |
| | | | | | (.111) | (.112) |
| $Mom\ Overlapped\ Dum_i$ | ... | ... | ... | ... | 1.73 | 2.11 |
| | | | | | (1.72) | (1.39) |
| $Reign\ w.\ Mom\ Alive_i$ | ... | ... | ... | ... | $-.150$ | $-.172$ |
| | | | | | (.131) | (.125) |
| $Lepanto\ War\ Dummy_i$ | ... | ... | ... | ... | ... | $-7.01^*$ |
| | | | | | | (2.42) |
| No. of obs. | 31 | 31 | 31 | 31 | 31 | 31 |
| $R^2$ | .401 | .695 | .704 | .724 | .771 | .810 |

Note: * and ** respectively denote significance at the 5 percent and 10 percent levels. Heteroskedasticity-corrected, robust errors reported. Dependent variable: total no. of new Ottoman-European conflicts that were initiated during the sultan's reign. Source for the conflict data: Brecke (1999). Source for population data: McEvedy and Jones (1978).

Finally, in column (6), I add the dummy for the Lepanto war, which indicates whether or not $i$ ruled before or after the Lepanto Sea Battle in 1571. Doing so retains European matrilineal descent as negative and statistically significant at the ten percent level. It also produces two statistically significant variables in the length of reign (positive) and the Lepanto-war dummy (negative).

As well, the impact of a European matrilineal descent on Ottomans' military activities is very large: taking the lowest statistically significant coefficient shown in column (6) and the average of 4.4 European-Ottoman wars per sultan, for example, we infer that European matrilineal descent lowered Ottomans' European conflict propensity by about two-thirds.

For further details, please see Iyigun (2013).

# 5 Chapter 8 Appendix

## 5.1 Assessing the Impact of Conflict on Fractionalization

We now turn to our primary focus that is the link between the long-run patterns of conflict and various measures of fractionalization. To that end, we cover the period between 1400 and 1900 CE to estimate the following regression:

$$\begin{aligned}
\mathit{Fractionalization}_i \quad &= \quad \lambda_0 \ + \ \lambda_1 \mathit{Total\ Conflicts}_i \\
\lambda_2 \mathit{Muslim\text{-}Christian\ Conflicts}_i &+ \ \lambda_3 \mathit{Protestant\text{-}Catholic\ Conflicts}_i \\
&+ \lambda_4 \mathit{Pogrom}_i \ + \ \lambda_5 \mathit{Duration\ of\ Total\ Conflicts}_i \\
&+ \lambda_6 \mathit{Duration\ of\ Muslim\text{-}Christian\ Conflicts}_i \\
&+ \lambda_7 \mathit{Duration\ of\ Protestant\text{-}Catholic\ Conflicts}_i \\
&+ \lambda_8 \mathit{Duration\ of\ Pogroms}_i + \ \lambda_9 \mathit{Other\ Controls}_i \ + \ \varepsilon_i,
\end{aligned} \tag{A.8.1}$$

where $\mathit{Fractionalization}_i$ is one of three alternative dependent variables constructed by Alesina et al. (2003); $\mathit{Total\ Conflicts}_i$ is the total number of violent confrontations that occurred within country $i$'s borders between 1400 CE and 1900 CE; $\mathit{Muslim\text{-}Christian\ Conflicts}_i$ is the count of violent confrontations between Muslims and Christians which took place in country $i$ over the relevant time span; $\mathit{Protestant\text{-}Catholic\ Conflicts}_i$ is the count of violent conflicts between Catholics and Protestants that occurred in country $i$ between 1400 CE to 1900 CE; $\mathit{Pogrom}_i$ is the number of Jewish pogroms which took place in country $i$ during the same period; and $\mathit{Duration\ of\ Total\ Conficts}_i$, $\mathit{Duration\ of\ Muslim\text{-}Christian\ Conficts}_i$, $\mathit{Duration\ of\ Protestant\text{-}Catholic\ Conficts}_i$, $\mathit{Duration\ of\ Pogroms}_i$ denote the average duration of the types of conflict, respectively.

In our most parsimonious empirical specifications, the set of control variables includes nine geographic dummy variables for *Western Europe, Central Europe, Eastern Europe, Northern Europe, the Balkans, Africa, Asia, the Middle East* and *islands*. Note that, taken together, two of those geographic dummies, *Eastern Europe* and *the Balkans*, define what turned out to be the historical buffer zone between Christian and Muslim societies. In other more comprehensive estimates, we also include as additional controls the population level of $i$ in 1994, the distance from the equator of country $i$'s capital, a dummy for whether or not $i$ is landlocked, country $i$'s land area in $km^2$, the population estimates for 1000 CE and 1500 CE, the distance of country $i$'s capital from the three ecclesiastical centers of Rome, Jerusalem and Mecca, dummies for whether a majority of the population was Christian or Muslim in 1994, and the years during which each of the four types of conflict took place on average.

Table A.8.1 displays results from four regressions that employ religious fractionalization as the dependent variable. Column (1) shows results from the most parsimonious of regressions, with controls only for geographic region. As mentioned earlier, certain areas of Europe tend to be more homogeneous than others, hence the addition of geographic dummies controls for regional differences. Column (2) adds *Land Area*, which is reported, though not significant, a dummy for whether the country is landlocked and current population, in case fractionalization is correlated with population size. [It is important to control for country size to the extent that country formation is endogenous and causality runs from violent confrontations to country size, which in turn affects our measures of fractionalization. Put differently, to the extent that the impact of conflicts on fractionalization arises from endogenous country formation, controlling for *Land Area* could help to limit omitted variable biases.]

Column (2) also adds variables for distance to the equator and a dummy for whether a country is landlocked. Column (3) builds on the specification in (2) with the additional variables of distance to major religious centers of Mecca, Rome and Jerusalem, as well as a dummies for whether the country had a Muslim or Christian majority in 1994, and its population in the years 1000 and 1500 CE. Of these, only the religious majority coefficients are reported. [The coefficients not shown typically are statistically insignificant, with occasionally alternating signs across the different empirical specifications.] Column (4) adds variables associated with the average year of the conflict both in general and by the types of religious conflict, although they are not reported. All in all, these additional control variables are highly correlated with duration and do not appear to have a large effect on magnitude or significance of the variables in question.

In all four regressions in Table A.8.1, religious fractionalization depends negatively and statistically significantly on the *frequency* of Muslim on Christian confrontations and typically positively—though not significantly—on violence between Protestants and Catholics. These results buoy the thesis that the long-run incidence and patterns of religious conflicts—in this case, those between Muslims and Christians—did impact the contemporaneous extent of religious fractionalization within countries. The role of historical conflicts in influencing modern-era fractionalization is quite large. In the simplest regression in Table A.8.1, for instance, one more violent incident in which Muslims fought Christians is associated with close to five percent less religious fractionalization, or a generally more homogenous religious community some 400 years later. The result increases in magnitude as controls are introduced and remains statistically significant. Additionally, we see that the *duration* of Muslim versus Christian conflicts enters negatively, decreasing fractionalization by 6 to 9 percent depending on the specification, though reaching statistical significance only in column (2). The *frequency* of Jewish pogroms is also associated with increased religious fractionalization, although the magnitude and significance varies by specification. However, the duration of pogroms is associated with decreased fractionalization.

While these baseline results show a pattern that will remain at the fore the rest of the way, they also invite the question of why Muslim on Christian conflicts had an opposite impact than those between Protestants and Catholics or Jewish pogroms. There is no clear cut answer to this. A plausible conjecture is that the types of conflict in question also differ from one another in the extent to which the underlying sources of conflict have been mitigated or resolved in the course of time—however, superficially or fundamentally that may be.

In particular, the process through which the Protestant and Catholic Christian denominations came to terms with their underlying differences was arduous and prolonged. The seeds of this confrontation lay in centuries past and the ‘heretical’ movements of Lollardy, Huguenots and Hussites. The confrontation spanned more than 130 years between the start of the Reformation in 1517 and its culmination with the Treaty of Westphalia signed at the end of the Thirty Years War in 1648. When this fundamental ecclesiastical disagreement was eventually resolved, religious pluralism started to become the accepted European norm.

**Table A.8.1:** Impact of Conflicts on Religious Fractionalization (1400 – 1900 CE)

| Dependent Variable: | Religious Fractionalization | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| *Total Conflicts* | .0008 | −.001 | .0002 | .003 |
| | (.002) | (.003) | (.006) | (.007) |
| *Muslim-Christian Conf.* | −.016** | −.020* | −.019** | −.022** |
| | (.008) | (.007) | (.010) | (.011) |
| *Protestant-Catholic Conf.* | .002 | −.0005 | .002 | .028 |
| | (.016) | (.018) | (.035) | (.051) |
| *Pogrom* | .117 | .218 | .329 | .682* |
| | (.153) | (.161) | (.199) | (.240) |
| *Duration of Total Conf.* | .053* | .054* | .062** | .053 |
| | (.025) | (.026) | (.032) | (.034) |
| *Dur. of Mslm-Chrst. Conf.* | −.031 | −.033** | −.039 | −.027 |
| | (.021) | (.019) | (.025) | (.029) |
| *Dur. of Prot.-Cath. Conf.* | .006 | .003 | .008 | .012 |
| | (.011) | (.010) | (.011) | (.025) |
| *Duration of Pogroms* | −.191 | −.347 | −.623* | −.136 |
| | (.246) | (.228) | (.285) | (.576) |
| *Balkans Dummy* | .532* | .509* | .333 | .416** |
| | (.075) | (.129) | (.213) | (.232) |
| *Eastern Europe Dummy* | .513* | .422** | .204 | .296 |
| | (.092) | (.239) | (.329) | (.383) |
| *Middle East Dummy* | .250* | .253* | −.014 | .040 |
| | (.063) | (.070) | (.192) | (.218) |
| $R^2$ | .439 | .478 | .586 | .616 |
| *No. of obs.* | 52 | 52 | 52 | 52 |

Note: * and ** respectively denote significance at the 5 percent and 10 percent levels. Heteroskedasticity-corrected standard errors reported in all regressions. Dependent variable: religious fractionalization in 2001; source: Alesina et al. (2003). Source of conflict data: Brecke (1999). Source of population data: McEvedy and Jones (1978). Geographic dummy variables for Northern, Central, Western Europe, Asia, Africa, the Middle East and islands included in all regressions but now shown. Controls for population, distance to equator, landlocked included in columns (2) through (4) but not shown. Population levels in 1000 and 1500, distance to Rome, Jerusalem and Mecca included in columns (3) and (4) but not shown. The average years of various categories of conflict included in column (4) but not shown.

We have thus seen that, with the exception of some of the geographic dummy variables that come in statistically significant, although not robustly to changes of empirical specification, only a few of the right-hand side variables, which we singled out above, have explanatory power. Despite this observation, the fit of the regressions, even of the baseline version, is quite high as indicated by the $R^2$ measures.

We then ran the same regressions shown in Table A.8.1 but with ethnic and linguistic fractionalization, respectively, as the dependent variables. Though the direction of the effect of religious conflicts on fractionalization was generally maintained, the impact of the latter on ethnic and linguistic fractionalization is overwhelmingly insignificant. One exception was provided by the statistically significant and negative impact of the *duration* of Muslim on Christian conflicts on ethnic fragmentation and the negative and significant role of pogroms on ethnic fractionalization in some specifications.

Interestingly, the coefficient on the frequency of total confrontations now entered negatively in five of the eight specifications, with three of the five also being statistically significant. In particular, the dampening influence of *Total Conflicts* on ethnic fractionalization in one regression and its similarly negative impact on linguistic fractionalization in two other regressions contrasted with the insignificant role of conflicts generally in religious fractionalization.

None of the other explanatory variables provided an evidently strong predictor of either ethnic or linguistic fractionalization. As discussed above, our data reflect a higher degree of religious fractionalization than either ethnic or linguistic. Thus, the lower levels and variance of ethnic and linguistic fractionalization might in part account for our results not being as strong as those reported in Table A.8.1. Still, the effects of our explanatory variables on ethnic fractionalization present slightly stronger and more uniform results over various specifications than linguistic fractionalization. This should again be viewed in light of the fact that our data reflect less linguistic fractionalization than ethnically.

Could it be the case that religious, ethnic or linguistic fractionalization is very persistent over time as a result of which our main results reflect the effects of fractionalization on conflicts and not the other way around? In this, we are encouraged by numerous factors already discussed herein, including the fact that, with very few exceptions, the European continent presented relatively low levels of fractionalization in the medieval period. Moreover, the addition of regional controls ought to account for outliers such as the Balkans and the Iberian Peninsula before 1492.

All the same, we decided to rerun our empirical tests using a three hundred-year time lag between our fractionalization observations and the conflict data. In particular, instead of tracking the patterns, types and attributes of violent confrontations over the half millennium between 1400 to 1900 CE, we generated an alternative variant of the conflict variables which was based on data covering the two centuries between 1400 and 1600 CE. This yielded 502 total conflicts in the 52 countries in our sample—instead of the 953 over the 500-year interval.

Tables A.8.2 provides the results derived using this new sample but otherwise replicating the empirical specifications shown in Table A.8.1. By incorporating a longer time lag, we see in Table A.8.2 that the effect of wars on religious fractionalization are very much in line with—and in some cases, in fact, stronger—than using the entire period 1400 to 1900 CE. Not only are the $R^2$ measures comparable if not better than those shown in Table A.8.1, but the three types of ecclesiastical conflict measures, *Muslim-Christian Conflicts*, *Protestant-Catholic Conflicts* and *Pogrom*, are statistically significant in nine out of 12 times and directionally always consistent with the Table A.8.1 results: Muslim on Christian confrontations that took place between the 15th and 17th centuries depressed the current-day religious fractionalization of countries, although only in the column (4) regression does the coefficient on *Muslim-Christian Conflicts* attain significance at the 10 percent level. By contrast, the Protestant on Catholic conflicts or Jewish pogroms that took place four centuries ago or earlier raised religious fractionalization, entering the four specifications always positively and significantly. For contrast, consider that *Muslim-Christian Conflicts*, *Protestant-Catholic Conflicts* and *Pogrom*, are statistically significant in only five out of 12 cases in Table A.8.1.

While other control variables are typically insignificant, the geographic dummies for the Middle East, eastern Europe and the Balkans in some specifications are significant. And in terms of the duration of conflicts we again have some evidence that longer religious conflicts—in this case, *Duration of Pogroms* only—typically reduced religious homogeneity. In terms of quantitative effects, the results we obtain with this longer-lag data are still stronger: in column (4) for instance, a ten percent higher incidence of Muslim on Christian wars is associated with close to a ten percent decrease in religious fractionalization, the magnitude of which is larger than the range implied by the regressions covering the entire 1400 to 1900 CE time period.

**Table A.8.2:** Impact of Conflicts on Religious Fractionalization (1400 – 1600 CE)

| Dependent Variable: | Religious Fractionalization | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| *Total Conflicts* | −.0003 | −.002 | .0003 | .007 |
| | (.003) | (.003) | (.007) | (.006) |
| *Muslim-Christian Conf.* | −.022 | −.026 | −.025 | $-.033^{**}$ |
| | (.016) | (.017) | (.024) | (.018) |
| *Protestant-Catholic Conf.* | $.047^{*}$ | $.049^{**}$ | $.063^{*}$ | $.355^{*}$ |
| | (.021) | (.023) | (.035) | (.072) |
| *Pogrom* | $.531^{*}$ | $.589^{***}$ | $.683^{**}$ | $1.64^{*}$ |
| | (.154) | (.155) | (.168) | (.300) |
| *Duration of Total Conf.* | .016 | .012 | .013 | −.028 |
| | (.011) | (.012) | (.012) | (.021) |
| *Dur. of Mslm-Chrst. Conf.* | −.010 | −.002 | .006 | .043 |
| | (.017) | (.015) | (.021) | (.027) |
| *Dur. of Prot.-Cath. Conf.* | −.005 | −.0001 | .009 | .001 |
| | (.018) | (.017) | (.021) | (.025) |
| *Duration of Pogroms* | $-9.48^{*}$ | $-9.68^{*}$ | $-9.57^{*}$ | $-385.3^{*}$ |
| | (3.62) | (3.63) | (3.767) | (72.16) |
| *Balkans Dummy* | $.444^{*}$ | $.415^{*}$ | .275 | .019 |
| | (.070) | (.136) | (.230) | (.330) |
| *Eastern Europe Dummy* | $.462^{*}$ | $.423^{**}$ | .328 | .077 |
| | (.069) | (.172) | (.336) | (.382) |
| *Muslim Majority* | ... | ... | −.179 | $-.363^{**}$ |
| | | | (.178) | (.187) |
| *Christian Majority* | ... | ... | −.142 | $-.278^{*}$ |
| | | | (.117) | (.132) |
| $R^2$ | .455 | .474 | .600 | .754 |
| *No. of obs.* | 52 | 52 | 52 | 52 |

Note: * and ** respectively denote significance at the 5 percent and 10 percent levels. Heteroskedasticity-corrected standard errors reported in all regressions. Dependent variable: religious fractionalization in 2001; source: Alesina et al. (2003). Source of conflict data: Brecke (1999). Source of population data: McEvedy and Jones (1978). Geographic dummy variables for Northern, Central, Western Europe, Asia, Africa, the Middle East and islands included in all regressions but now shown. Controls for population, distance to equator, landlocked included in columns (2) through (4) but not shown. Population levels in 1000 and 1500, distance to Rome, Jerusalem and Mecca included in columns (3) and (4) but not shown. The average years of various categories of conflict included in column (4) but not shown.

The results using only the period 1400 to 1600 CE exhibit similar tendencies to those where the entire period was in use. In particular, our conflict data aren't as powerful in explaining ethnic or linguistic fractionalization as they are in religious fractionalization. With this sample, *Total Conflicts* has a depressing effect in one specification with ethnic fractionalization as the dependent variable and it has such an effect in two regressions where linguistic fractionalization is the dependent variable. This is in clear contrast to the results with religious fractionalization, which do not yield any explanatory power to the overall level of conflicts in fractionalization. The one significant difference between these results vis-a-vis those reported in Table A.8.1 is that *Pogrom* has a statistically significant, positive impact on ethnic and linguistic fractionalization in seven of the eight specifications, whereas *Duration of Pogroms* has a negative and statistically significant impact on ethnic and linguistic fractionalization in six of the eight regressions shown. This effect is in line with those for religious fractionalization reported in Table A.8.1, but they are in contrast with those in Table A.8.2, where the impact of conflicts over the longer time horizon of 1400 to 1900 CE on ethnic and linguistic fractionalization is shown to be typically insignificant.

A four-century lag between measures of conflict and fractionalization provides us some comfort that we are distilling off any impact fractionalization could have on conflicts. Nonetheless, even a four century lag would not compensate for omitted variable biases inherent in the results above. This is why we controlled for the dates of independence in some alternative estimates and substituted more or less aggregated geographic controls for countries in Europe in various other regressions. Neither of these alterations influenced the essence of our findings. Furthermore, for an empirical work whose key explanatory data cover the medieval era, our $R^2$ measures are unusually high, exceeding .75 in some specifications where religious fractionalization is the dependent variable. This is another reason why omitted variable biases are probably not exerting a meaningful bias in the results.

For further empirical work and issues related to the material above as well as those in the next chapter, please see Fletcher and Iyigun (2009).

# 6 Chapter 9 Appendix

## 6.1 Conflict, Institutions & Borders

As a starting point, we'd like to investigate if conflicts alone can help to explain differences in institutional quality. Or if ethnic, religious or linguistic fractionalizations come to bear on institutional features as well even when one accounts for the role of the long-term history of conflicts on institutions. To that end, we shall estimate a simple Ordinary Least Squares (OLS) regression that is very similar to the one we utilized in Chapter 8. In particular,

$$\begin{aligned} \textit{Polity Score}_i &= \lambda_0 + \lambda_1 \textit{Muslim-Christian Conflicts}_i \\ \lambda_2 \textit{Muslim-Muslim Conflicts}_i &+ \lambda_3 \textit{Christian-Christian Conflicts}_i \qquad \text{(A.9.1)} \\ &+ \lambda_4 \textit{Other Controls}_i + \varepsilon_i, \end{aligned}$$

where $\textit{Polity Score}_i$ is a country $i$'s political quality score based on the Polity IV dataset and $\textit{Muslim-Christian Conflicts}_i$, $\textit{Muslim-Muslim Conflicts}_i$, $\textit{Christian-Christian Conflicts}_i$, respectively, are the counts of violent confrontations between the labeled parties that took place in country $i$ over the years between 1400 and 1900 CE. The other controls in our baseline regressions include many of the standard variables we utilized in Chapter 8.

Table A.9.1 reports our findings based on the regression in equation (9.1) above, with countries' polity scores as the dependent variable, regressed on our set of standard explanatory variables. As shown, we pick up a strong impact of the history of conflicts over the period between 1400 to 1900 CE on the quality of polities in 1994. Whereas the incidence of Muslim versus Christian conflicts and intra-Islam confrontations had a dampening effect on religious fractionalization, they are shown to have had positive and, in five of the six specifications, statistically significant effects on polities. As was the case with religious fractionalization, the incidence of intra-Christianity conflicts had no meaningful bearing on polity scores.

**Table A.9.1:** Impact of Conflicts on Polity Scores (1400 – 1900 CE)

| Dependent Variable: | Polity Score | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *Muslim-Christian Conf.* | 0.113* | 0.399** | 0.311*** | 0.268** | 0.259* | 0.282* |
| | (0.0477) | (0.126) | (0.0440) | (0.0735) | (0.116) | (0.102) |
| *Muslim-Muslim Conf.* | 0.161*** | 0.150* | 0.183* | 0.244* | 0.248 | 0.0699 |
| | (0.0169) | (0.0655) | (0.0817) | (0.0956) | (0.134) | (0.0546) |
| *Christian-Christian Conf.* | -0.0275* | 0.0271 | 0.0199 | 0.0225 | 0.00736 | -0.0617** |
| | (0.0101) | (0.0234) | (0.0185) | (0.0287) | (0.0406) | (0.0170) |
| *Middle East Dummy* | 1.874*** | 0.766 | 0.434 | 1.207 | 2.122 | 9.039* |
| | (0.103) | (0.658) | (1.171) | (1.098) | (3.604) | (3.729) |
| *Balkans Dummy* | 6.563*** | 2.263 | 0.192 | 2.629 | 3.219 | 6.644*** |
| | (0.390) | (2.669) | (3.410) | (3.598) | (4.794) | (0.388) |
| *Island Dummy* | 14.21*** | 10.99** | 7.126 | 8.709 | 12.00** | 19.65*** |
| | (0.317) | (2.455) | (4.579) | (4.511) | (3.584) | (2.145) |
| Population Density | | 13.80 | 11.31* | 14.17* | 14.12* | |
| | | (7.200) | (4.173) | (5.323) | (5.995) | |
| *Muslim Majority* | | | -1.730 | -1.630 | -1.660 | |
| | | | (2.962) | (3.119) | (2.737) | |
| *Christian Majority* | | | 2.811 | 3.311 | 2.851 | |
| | | | (3.939) | (3.904) | (2.386) | |
| Obs. | 53 | 53 | 53 | 52 | 52 | 52 |
| R-squared | 0.678 | 0.765 | 0.786 | 0.799 | 0.819 | 0.747 |

Standard errors clustered regionally (in parentheses)
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note: Dependent variable: religious fractionalization in 2001; source: Alesina et al. (2003). Source of conflict data: Brecke (1999). Source of population data: McEvedy and Jones (1978). Geographic dummy variables for Western Europe, Eastern Europe, Central Europe, Asia and Africa included in all regressions but now shown. Distance to equator, land areas, an indicator of land-locked countries included in columns (2) through (6) but not shown. Population densities in 1000 CE and 1500 CE included in columns (3) through (6) but not shown. Distance to Mecca, Jerusalem and Rome included in the final two regressions but not shown.

The existing literature on the subject has long established a generally robust adverse impact of fractionalization on measures of institutional quality. And though for the sake of brevity we have chosen not to present them here, estimating the analogs of the regressions in Table A.9.1, but replacing our conflict measures with the three fractionalization measures, we too were able to verify the statistically significant, detrimental effects of ethnic and linguistic fractionalization on polity scores.

Along with what we documented in Table A.9.1, these findings raise an intriguing question: If fractionalization is influenced in part by violent conflicts and religious confrontations, which, together with fractionalization, then have a bearing on the cross-country differences of polity strength, do violence and religious confrontations have a *direct* long-term impact on polity scores or do they impact on polities only *indirectly* through fractionalization?

In Table A.9.2 we explore this issue. As seen, when we include the three measures of fractionalization along with the standard list of conflict variables we relied upon in the previous table, we find that neither religious nor linguistic fractionalization impacts cross-country differences in institutional quality, as proxied by polity scores. By contrast, ethnic fractionalization is a strong negative predictor of institutional quality across countries. Interestingly, Christian versus Muslim conflicts and Muslim against Muslim confrontations continue to show significant and positive effects on institutional quality. For instance, the frequency of Muslim versus Christian violent conflicts has positive coefficients in five of the six specifications and it is statistically significant at the 5 percent or higher level in all of those five regressions.

As a side note, to see if violent conflicts impacted a narrower measure of polity, we ran regressions similar to the one we discuss here, using the democracy index score as the dependent variable instead. Doing so we generally found conflicts to have insignificant effects on democracy.

**Table A.9.2:** Impact of Conflicts versus Fractionalization on Polity Scores (1400 – 1900 CE)

| Dependent Variable: | Polity Score | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *Muslim-Christian Conf.* | 0.113 | 0.356** | 0.267*** | 0.238*** | 0.208** | 0.213** |
| | (0.0534) | (0.114) | (0.0542) | (0.0449) | (0.0509) | (0.0748) |
| *Muslim-Muslim Conf.* | 0.209*** | 0.158*** | 0.204*** | 0.263*** | 0.258* | 0.123** |
| | (0.0364) | (0.0284) | (0.0209) | (0.0391) | (0.110) | (0.0416) |
| *Christian-Christian Conf.* | -0.0431** | 0.00676 | -0.00419 | -0.00524 | -0.00381 | -0.0553*** |
| | (0.0119) | (0.0253) | (0.0164) | (0.0210) | (0.0355) | (0.00621) |
| *Religious Fractionalization* | 2.500 | 0.578 | 0.969 | 1.379 | -0.201 | 0.699 |
| | (2.966) | (3.091) | (3.219) | (3.384) | (2.368) | (1.699) |
| *Ethnic Fractionalization* | -9.079** | -6.547* | -6.863 | -6.387 | -5.560* | -7.077*** |
| | (1.985) | (2.388) | (3.291) | (3.392) | (2.409) | (1.452) |
| Linguistic *Fractionalization* | 0.784 | 0.870 | 0.636 | -0.489 | -0.177 | 0.961 |
| | (1.411) | (0.926) | (1.461) | (1.947) | (1.607) | (2.559) |
| *Population Density* | | 9.355 | 5.901 | 8.084 | 9.521 | |
| | | (7.637) | (3.970) | (4.902) | (7.692) | |
| *Muslim Majority* | | | -2.668 | -2.832 | -2.512 | |
| | | | (2.521) | (2.593) | (1.970) | |
| *Christian Majority* | | | 2.332 | 2.494 | 2.219 | |
| | | | (3.432) | (3.519) | (2.614) | |
| Obs. | 52 | 52 | 52 | 51 | 51 | 51 |
| R-squared | 0.741 | 0.793 | 0.818 | 0.830 | 0.845 | 0.788 |

Standard errors clustered regionally (in parentheses)
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note: Dependent variable: religious fractionalization in 2001; source: Alesina et al. (2003). Source of conflict data: Brecke (1999). Source of population data: McEvedy and Jones (1978). Geographic dummy variables for Western Europe, Eastern Europe, Central Europe, Asia and Africa included in all regressions but now shown. Distance to equator, land areas, an indicator of land-locked countries included in columns (2) through (6) but not shown. Population densities in 1000 CE and 1500 CE included in columns (3) through (6) but not shown. Distance to Mecca, Jerusalem and Rome included in the final two regressions but not shown.

A potential shortcoming of the analyses thus far in this chapter stems from the fact that our units of observation are based on countrywide data, although country size and border formations are obviously endogenous. This would be most relevant for our findings to the extent that causality runs from violent confrontations to country size and formation, to measures of fractionalization. To account for such effects and channels of causality, we typically controlled for land area and dates of independence. Neither of these controls had significant effects on fractionalization, although the role of violent conflicts remained robust to the inclusion of the controls. We find this indicative of the fact that the history of conflicts had independent effects on fractionalization which went beyond any role it brought to bear on country size and formation.

In what follows, we can in fact explore the determinants of conflict and state formation based on the same underlying data we employ here. Based on data from Iyigun, Nunn and Qian (in progress), our cross-section units of observation are now 50-by-50 cells covering Europe, Middle East, North Africa. Moreover, conflict and state borders data are organized as a panel covering seven time periods at the top of each century from 1400 CE to 2000 CE.

We can use these data primarily to test the determinants of conflict as well as state formation and consolidation geographically over time. To that end, we have at our disposal three alternative polity size measures. One of them, which we shall define as $Within\ Border_{it}$, is a dummy for whether or not cell $i$ fell strictly within the domain of a politically independent unit at time $t$. Next, we have a measure of the land area of the political unit cell $i$ was associated with at time $t$, $Polity\ Size_{it}$. Third, we can use the number of political units that appear in cell $i$ at time $t$, which we shall label as $Number\ of\ Polities_{it}$.

Note that $Within\ Border_{it}$, as well as $Polity\ Size_{it}$ would be alternative but positive measures of political consolidation, whereas $Number\ of\ Polities_{it}$ ought to be associated positively with political fragmentation. Also, $Within\ Border_{it}$ and $Number\ of\ Polities_{it}$ are more localized measures of political unity, whereas $Polity\ Size_{it}$ captures the extent to which any given cell is politically associated with neighboring cells and beyond.

With these definitions and data in hand, we are now in position to examine the extent to which our ecclesiastical conflict measures affect the three alternative political fragmentation measures using their panel. In particular, we can estimate

$$
\begin{aligned}
\textit{State Formation}_{it} \quad = \quad & \lambda_0 \ + \ \lambda_1 \textit{State Formation}_{it-1} + \lambda_2 \textit{Muslim-Christian Conflicts}_{it-1} \\
& + \lambda_2 \textit{Christian-Christian Conflicts}_{it-1} + \ \lambda_3 \textit{Muslim-Muslim Conflicts}_{it-1} \qquad \text{(A.9.2)} \\
& + \sum_c \gamma_c \textit{Cell Dummy}_i^c \ + \sum_{j=1400}^{2000} \rho_j \textit{Time-period Dummy}_t^j + \ \varepsilon_i,
\end{aligned}
$$

where *State Formation*$_{it}$ is one of three alternative political fragmentation variables we just defined; and *Muslim-Christian Conflicts*$_{it-1}$, *Christian-Christian Conflicts*$_{it-1}$, *Muslim-Muslim Conflicts*$_{it-1}$ are the analogs of our standard conflict measures constructed at the cell and time period disaggregation level and lagged one century.

For our baseline results, we observe our political fragmentation variable, *State Formation*$_{it}$, at the top of each century between 1500 and 2000 CE and we aggregate our explanatory variables over the periods of 1400-1499, 1500-1599, 1600-1699, 1700-1799 and 1800-1899.

Our findings are reported in Table A.9.3. As shown in column (1), neither Christian versus Muslim conflicts nor intra-religious feuds averaged over a given century impacted whether or not a given cell fell strictly within the borders of a polity in the subsequent century. In contrast, more intra-Christian conflicts within a cell did make it more likely that it was politically fragmented later on, given the results in column (2). And *Muslim-Christian Conflicts* had a similar fragmentary effect according the estimates shown in our final column of Table A.9.3.

We interpret this to be evidence consistent with our earlier findings: Christian versus Muslim conflicts and Muslim versus Muslim confrontations not only produced more religious homogeneity within country borders, but they also reshaped them. By producing more political fragmentation, ecclesiastical conflicts might have had an influence on cross-country measures of fractionalization too.

Recall that the history of conflicts by the religious identity of the parties involved have less statistical power in explaining the extent to which countries were religiously fragmented in 1900.

In culmination, we have established since Chapter 5 that religious identities and their differences affected patterns of conflict and political rivalries in the Old World. Based on data from 1400 CE to the late-20th century, we were able to validate and quantify this claim. In our last two chapters, we also saw how those conflicts left observable and measurable sociopolitical imprints, ranging from the extent to which modern-day countries in Europe, Middle East, Near East and North Africa are religiously or ethnically homogenous to the quality of polities. Equally if not more importantly, we found that the patterns of religiously-motivated conflicts over the very long term came to bear on political borders, country sizes and their fragmentation as well.

**Table A.9.3:** Impact of Conflicts on Political Fragmentation (1400 – 1900 CE)

| *Dependent Variable:* | *Within Border* | *Number of Polities* | *Polity Size* |
|---|---|---|---|
| | (1) | (2) | (3) |
| *Muslim-Christian Conflicts* | 0.00136 | 0.0559 | -2.966e+11*** |
| | (0.0334) | (0.0806) | (1.121e+11) |
| *Muslim-Muslim Conflicts* | -0.0109 | 0.139 | 9.316e+10 |
| | (0.0567) | (0.137) | (1.983e+11) |
| *Christian-Christian Conflicts* | -0.0154 | 0.212*** | -7.704e+10 |
| | (0.0209) | (0.0504) | (6.985e+10) |
| *Lagged Dependent Variable* | 0.0762*** | 0.192*** | 0.0254 |
| | (0.0135) | (0.0134) | (0.0172) |
| *Year 1500 Dummy* | -0.180*** | -0.0231 | -7.539e+11*** |
| | (0.00984) | (0.0236) | (4.710e+10) |
| *Year 1600 Dummy* | -0.136*** | -0.0480** | 4.880e+11*** |
| | (0.00987) | (0.0236) | (4.708e+10) |
| *Year 1700 Dummy* | -0.111*** | 0.828*** | 5.512e+11*** |
| | (0.00980) | (0.0215) | (4.030e+10) |
| *Year 1800 Dummy* | -0.0748*** | -0.0369 | 1.386e+12*** |
| | (0.00977) | (0.0236) | (4.415e+10) |
| *Year 1900 Dummy* | 0.312*** | -0.0282 | 9.147e+11*** |
| | (0.00774) | (0.0236) | (4.024e+10) |
| Obs. | 7730 | 7730 | 5167 |
| R-squared | 0.664 | 0.731 | 0.700 |

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note: Cell fixed effects included in all specifications but not shown.