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:

$$\begin{aligned} \log h_{i,t} &= \lambda_0 + \lambda_1 Monotheist_i + \lambda_2 Monotheist_i * Birth\ Year_i \\ &\quad + \lambda_3 Other\ Controls_i + \upsilon_i, \end{aligned} \tag{A.2.2}$$

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):

$$\begin{aligned} \textit{Peak Land Mass}_i \quad = \quad & \lambda_0 + \lambda_1 \textit{Monotheist}_i + \lambda_2 \textit{Monotheist}_i * \textit{Birth Year}_i \\ & + \lambda_3 \textit{Other Controls}_i + \varepsilon_i \end{aligned} \tag{A.2..3}$$

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).