DOES RELIGION AFFECT ECONOMIC GROWTH AND HAPPINESS? EVIDENCE FROM RAMADAN*

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We study the economic effects of religious practices in the context of the observance of Ramadan fasting, one of the central tenets of Islam. To establish causality, we exploit variation in the length of daily fasting due to the interaction between the rotating Islamic calendar and a country's latitude. We report two key, quantitatively meaningful results: (i) longer Ramadan fasting has a negative effect on output growth in Muslim countries, and (ii) it increases subjective well-being among Muslims. We find evidence that these patterns are consistent with a standard club good explanation for the emergence of costly religious practices: increased strictness of fasting screens out the less committed members, while the more committed respond with an increase in their relative levels of participation. Together, our results underscore that religious practices can affect individual behavior and beliefs in ways that have negative implications for economic performance, but that nevertheless increase subjective well-being among followers. *JEL* Codes: E20, O40, O43, Z12.

I. INTRODUCTION

Religions are ubiquitous across human societies. It is thus natural to speculate that they may affect important economic outcomes, such as economic growth—as many have done dating at the very least to Weber's (1930 [1905]) celebrated work. While this possibility is certainly appealing, assessing its prevalence and importance is a rather complicated task, both conceptually and empirically, not the least because religions are multifaceted

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social phenomena whose different aspects could most likely have different effects.

That said, one fundamental aspect that is common to all forms of religion is that they prescribe rules of behavior, or practices, that constrain followers, with varying degrees of strictness. First, religious practices impose an immediate trade-off, as they require time and resources that are then unavailable for production. Second, they could also directly affect productivity, for instance by limiting social interactions with nonbelievers or by imposing dietary restrictions. Third, they may shape beliefs and values that determine economic decisions.

The recent empirical literature that has studied the relationship between religion and economic performance—after years of relative neglect from economists—has found a negative correlation between religious behavior (e.g., attendance at religious services) and economic growth (Barro and McCleary 2003; McCleary and Barro 2006), and between religiosity and income at the cross-country and individual levels (e.g., Barro and McCleary 2003). However, as religious behavior and religiosity are endogenous and could well be affected by economic growth itself, convincing evidence that there is a causal effect driving these relationships has proved elusive.[1] This challenge is even thornier when it comes to identifying the effects of the constraints on behavior imposed by religious practices, since these should be understood as equilibrium outcomes that can be affected by the economic environment.

We present the first estimate of a causal effect of the strictness of a religious practice on economic growth. We do so by focusing on the specific example of fasting in observance of the Islamic holy month of Ramadan. Ramadan fasting is surely a very prominent example of religious practice: as one of the Five Pillars of Islam, its observance is understood to be obligatory for all billion-plus Muslim believers. This religious practice has a well-defined rule specifying that Muslims shall fast from dawn to sunset, and as the month of Ramadan rotates over the seasons according to the lunar calendar, it also provides us with an ideal

1. The causal identification challenge was obviously acknowledged by the literature. For instance, Barro and McCleary (2003) try to address it using instrumental variables (e.g., presence of a state religion). While reassuring with respect to reverse causality, the limitations of their empirical setting do not let them deal with omitted variables.

context for dealing with the causal identification issues that confound the study of the links between religious practices and economic outcomes.

To give a concrete example, when Ramadan falls in the Northern Hemisphere winter, the prescribed length of daily fasting according to the Qur'an will be longer in Bangladesh than in Turkey, because Bangladesh is closer to the Equator. However, when Ramadan falls in the summer, fasting will be longer in Turkey than in Bangladesh. This interaction of latitude and the cyclical properties of the lunar calendar being exogenous to our outcomes of interest, we thus have an ideal source of idiosyncratic variation in the prescribed strictness of the practice.

Using country-level panel data, we show that longer prescribed Ramadan fasting has a robust negative effect on output growth in Muslim countries, whether measured by GDP per worker, GDP per capita, or total GDP, and whether measured in yearly rates or aggregated up to five-year periods. Most reassuringly, we find no effect whatsoever on GDP growth in non-Muslim countries, underscoring that the result is unlikely to be spurious.

Quantitatively, our estimates imply a difference in growth rates between Bangladesh and Turkey of the order of 1 percentage point, or about 0.15 standard deviation, at the peak and trough of Ramadan fasting hours, at which the difference in the lengths of fasting between the two countries is of 1.4 hours, or just over 1 standard deviation. While the symmetry in the Ramadan cycle implies that there is no divergence in performance over time, our estimates imply a substantial economic cost stemming from more demanding Ramadan fasting.

We then use the same empirical strategy to estimate the causal effect of the strictness of Ramadan fasting on subjective well-being (SWB). Using data from the World Values Survey, we find that increased Ramadan fasting requirements lead Muslim individuals to report greater levels of both happiness and life satisfaction. Once again, we find no effect whatsoever on the SWB of non-Muslim individuals in non-Muslim countries.

Our evidence thus indicates that exogenously requiring Muslims to fast longer, for religious reasons, has a net positive impact on their SWB: put simply, it makes them happier in spite of making them relatively poorer. This is particularly interesting since recent research has provided evidence that economic growth leads to higher SWB at the cross-country level (Stevenson and Wolfers 2008), in contrast with the well-known

"Easterlin paradox" (Easterlin 1974). Therefore, to the extent that lower GDP growth causally reduces SWB, our results show that this effect is trumped by the nonpecuniary benefits of the practice on SWB.

To understand these results, we resort to the well-known club good model of costly religious practices (Iannaccone 1992). This framework provides a coherent explanation for the puzzling existence and persistence of practices that are evidently costly and with no apparent economic benefit, by showing that they can improve the welfare of members of a religious community. In essence, it shows that such practices may work as a mechanism for screening out individuals who are less committed to exerting effort within the community, as well as reducing the threat of free-riding, thereby increasing the intensity of participation of remaining members and the provision of the club good entailed by that religious engagement.

The evidence supports the predictions of this model. First, we find that membership in voluntary religious organizations decreases as a result of the stricter Ramadan fasting requirements, and this is in turn matched by increased membership in nonreligious groups. This is consistent with a role of increased strictness as a screening mechanism. Second, we find that individuals whose demographic characteristics predict them to be less religiously committed decrease their level of engagement as measured by mosque attendance. In contrast, the more committed increase their engagement, as would result from the decreased threat of free-riding.

We also find evidence that increased strictness affects beliefs, in ways likely mediated by their effect on patterns of socialization. In particular, there is a negative effect of increased Ramadan required fasting hours on generalized trust. Although we cannot rule out other possible mechanisms linking increased strictness and trust, this is consistent with the idea that religious organizations may be especially effective in generating trust (Putnam and Campbell 2010), and that the substitution of nonreligious for religious engagement induced by the increased strictness may have broader implications for social capital.

Last but not least, our results suggest that the impact of Ramadan on economic growth is likely to go beyond the immediate effect of fasting on productivity. On the one hand, evidence on employment and wages in manufacturing is consistent with an impact on labor supply decisions—both directly and indirectly,

via beliefs about the relative importance of work, which we also show to be affected. In addition, to the extent that productivity constitutes a channel of influence, the evidence that increased fasting hours affects beliefs, such as trust, indicates that this would operate over a longer span of time.

In sum, the case of Ramadan illustrates that religious practices can entail significant implications at the aggregate level, while still providing measurable benefits, at least partly due to their role as costly screening devices. This could well be true of other kinds of religious activity that play a similar role. To be sure, neither our results nor those of the extant literature should be interpreted as implying that religion, broadly understood, necessarily causes poor economic performance. Just as important, we focus on costly religious practices, and other aspects of religion could have much different effects.[2]

Besides the aforementioned literature on religion and income and growth, our article also relates to a number of additional strands. First, we provide causal evidence in support of the club good theory of costly religious practices, showing that exogenous variation in strictness leads to screening, and changes in religious engagement, as predicted by the economic approach put forth and surveyed by Iannaccone (1992, 1998). This is particularly important given the alternative arguments to explain the persistence of costly religious practices, ranging from psychological (e.g., Plante and Sherman 2001) to evolutionary (e.g., Hinde 2010).

We also relate directly to the literature that has studied the links between religion and SWB. It has typically found that religious engagement and religiosity are associated with higher levels of SWB at the individual level (e.g., Ellison 1993; Dolan, Peasgood, and White 2008; Deaton and Stone 2013). However, whether such associations can be given a causal interpretation remains very much an open question, as endogeneity issues pose a fundamental challenge in this literature as well (Argyle 2003; Francis 2011).[3] Our contribution here is to provide evidence of

2. For instance, Barro and McCleary (2003) and McCleary and Barro (2006) find a positive relationship between economic growth and religious beliefs such as belief in hell. For skeptical takes on this result, see Young (2009) and Durlauf, Kourtellos, and Tan (2012).

3. Clingingsmith, Khwaja, and Kremer (2009) document that the Hajj pilgrimage to Mecca, another of the Five Pillars of Islam, leads to an increase in negative feelings suggesting distress (for women only). However, they find no effect on

that sort, though our source of variation is at the country level, and also address the tension between the findings in this literature and those in the work focusing on religion and growth.

Others have studied the effects of adherence to different religions on a number of economic and political outcomes (Barro 1997; La Porta et al. 1999) or used survey evidence to study the connection between religiosity and economic attitudes (Guiso, Sapienza, and Zingales 2003).[4] We differ in that we focus on a specific example of religious practice, which lets us deal with the issue of identifying a causal effect and considering specific mechanisms. More broadly, we build on the now vast literature documenting the effects of culture—of which religion is certainly a very important component—on a number of economic outcomes (see Guiso, Sapienza, and Zingales 2006 for an early survey, and Nunn 2012 for a more recent discussion). Of note, we find evidence of a causal effect of religious practices on trust, which substantiates the related strand that has studied that link (Guiso, Sapienza, and Zingales 2003; Sosis 2005; Putnam and Campbell 2010; Berggren and Bjornskov 2011).

Our use of micro-evidence to study the impact of religion on individual economic decisions also puts us in line with a recent and growing literature that looks at specific topics such as work ethic (Spenkuch 2011), entrepreneurship (Audretsch, Boente, and Tamvada 2007), loan repayment decisions (Baele, Farooq, and Ongena 2011), and human capital accumulation (Becker and Woessmann 2009), among others. Within this literature, our article is closest to Clingingsmith, Khwaja, and Kremer (2009), who study the impact of the Hajj. Consistent with our evidence, they also find an important impact of this practice on individual views and beliefs.

Last but not least, our article relates to a relatively small literature in economics that has studied the effects of Ramadan fasting. Almond and Mazumder (2011) use the variation of the timing of Ramadan over the years to identify negative effects of

self-reported life satisfaction. Lim and Putnam (2010) argue for an effect of religious engagement on SWB, using panel data to control for unobserved individual characteristics.

4. In particular, those studies tend to find a negative coefficient for Muslim adherence in regressions focusing on growth or institutional development. Our results do not speak directly to that, since we focus on one specific aspect of Islam. Kuran (2004) provides an extensive discussion of possible economic implications of Islamic institutions.

fasting during early pregnancy on birth weight and long-term disabilities. Van Ewijk (2011) and Majid (2013) use a similar strategy to study effects on individual long-run health and labor market outcomes. Besides their focus on individual outcomes, the nature of the variation used by these studies (entirely within-country) precludes the use of the interaction between timing and latitude, which affords us cleaner identification. Still, that evidence points at the possibility of long-run economic costs of fasting (at least as it pertains to pregnant women), which lies beyond the scope of what we study.

On a different vein in this literature, Schofield (2014) uses variation in the timing of Ramadan relative to the agricultural season, interacted with Muslim presence across Indian districts, to estimate a negative effect of Ramadan fasting on agricultural output. This is broadly consistent with our findings, though that paper attributes the effect to the direct effect of fasting on nutrition and productivity. However, her source of variation does not relate to the strictness of the practice, and her paper focuses only on labor supply and productivity reactions in the very short run, namely, during the month itself. This precludes an analysis of the kind of responses this article studies.

The remainder of the article is organized as follows. Section II lays out some background on Ramadan practices, Section III describes the data and empirical strategy, and Section IV presents the basic results on growth and SWB. Section V then discusses the evidence on mechanisms, and Section VI concludes.

II. BACKGROUND

Ramadan is the ninth month of the Islamic (*Hijri*) calendar, and is considered sacred as the month in which the Prophet Muhammad first received revelations. Fasting (*sawm*) during that month is one of the Five Pillars of Islam—the five basic acts that are considered an obligation for all believers and the foundation of Muslim life. The fasting encompasses abstention from food and drink, as well as smoking and sexual activities, between dawn and sunset during the entire month.[5]

5. There are exemptions from the obligation, typically for children, the ill and the elderly, travelers, and breastfeeding women.

Ramadan fasting entails obvious physiological consequences because of the constraints it places on the ingestion of food and liquids, and these have been extensively studied in the medical literature. Not surprisingly, the literature has consistently found body weight loss and significant metabolic changes (e.g., Hallak and Nomani 1988; Ziaee et al. 2006). In addition, Leiper, Molla, and Molla (2003) summarize the research as finding symptoms such as irritability, headaches, sleep deprivation, and lassitude being commonly reported, although with few major health problems.

More broadly, it stands to reason that these effects would have potential implications for productivity at work. Indeed, research has found significant prevalence of individuals reporting tiredness and unwillingness to work, as well as reduced levels of activity and concentration ability, during the month of Ramadan (Afifi 1997; Karaagaoglu and Yucecan 2000). More specific studies focusing on worker productivity in heavy labor activities have also found "evidence of [. . .] substantial health hazard to Islamic workers in such situations," going as far as "strongly [urging] employers to refrain from assigning Islamic workers to heat work or heavy daytime work during Ramadan" (Schmahl and Metzler 1991). In short, there is strong indication that Ramadan fasting affects followers in ways that affect their productivity at work, although any negative effects seem unlikely to persist beyond the fasting period (Toda and Morimoto 2004). Consistent with that, a recent survey on the impact of Ramadan on productivity (Dinar Standard 2011) finds that up to one in four Muslim professionals admits to not maintaining the same level of productivity compared with other months.

No less important are the broader effects of Ramadan on individual lifestyle and social life during the holy month (Maqsood 2007; Marshall Cavendish Corporation 2010). The daily routine incorporates major predawn (*suhur*) and fast-breaking (*iftar*) meals, which are social events involving family, friends and acquaintances, and coworkers—turning iftar in particular into a "unique opportunity for socializing" (Chenar 2011). Iftar events often take place in mosques, which, more broadly, typically hold many special events throughout the month. As a result of this, and of the additional *tarawih* prayers that are meant to be performed on Ramadan evenings (beyond the five daily prayers that are another Pillar of Islam), increased mosque-going is an

important feature of the period.[6] Major festivities also mark the end of the month, with the fast-breaking festival of Eid al-Fitr.

Not all Ramadan practices are of a social nature, of course. Indeed, the (optional) ritual of *i'tekaf* ("staying in one place") is a traditional part of the last 10 days of the month, and reading the Qur'an is also strongly encouraged. Consistent with that, for instance, Afifi (1997) reports that fasting individuals tend to get more involved in "stress-reducing" (such as watching TV, listening to radio, or visiting friends) and "spiritual" activities (such as praying and reading the Qur'an).

Given all of these unique features and practices that take place during the holy month, one might expect that Ramadan would affect individual decisions and the formation of economically relevant beliefs in ways that could in turn extend the impact of Ramadan beyond the month itself.

Obviously, adherence to each specific Ramadan practice will vary tremendously across individuals and countries, and this is very hard to observe on a systematic basis. However, our empirical strategy takes advantage of factors that will exogenously shock the strictness of the fasting requirement to identify the impact of the practice on our outcomes of interest.

Our strategy, as we discuss later in greater detail, is based on the fact that the Islamic calendar is lunar, so that months correspond to lunar cycles (around 29.5 days). As a result, the year is 10 to 11 days shorter than the solar year and, in the absence of leap years, the months rotate over the seasons accordingly, in cycles of roughly 33 years. This means that the number of hours of daily fasting—corresponding to the period between dawn and sunset—will vary depending on the time of the year in which Ramadan happens to fall in any given year and also on latitude.

Longer hours obviously amplify the physiological impact of going without food and drink and of the fewer hours of sleep that come from having to wake up for predawn meals. Just as important, dealing with that impact requires changes in daily routines and activities that affect the broader lifestyle changes we have

6. Tarawih prayers are not mandatory, but are considered highly desirable nonetheless. They should preferably be performed in a mosque congregation, but can also be done at home.

discussed.[7] As a result, the length of required fasting hours constitutes an ideal source of variation in the strictness of Ramadan practices.

III. Empirical Framework

III.A. Data

Our first key variable is the number of stipulated fasting hours during Ramadan.[8] To calculate that, we collect data from the Astronomical Applications Department of the U.S. Naval Observatory. Their online data service provides sunrise and sunset times for any geographic coordinate on Earth, at any given date in the Gregorian calendar. To map historical Ramadan dates from the Islamic calendar to the Gregorian calendar, we use data from Islamic Philosophy Online.[9] For each Ramadan since 1950, we calculate the average daily daylight hours during Ramadan in every country and year.[10]

7. Indeed, it is not hard to find reports underscoring that point in the context of summer Ramadans. They seem to entail more time spent with family, in worship, and in contemplative activities, as well as a general "slowdown" in daily activities so as to conserve energy and avoid the ill effects of heat and humidity. For instance, a Canadian report (Escott 2013) quotes individuals stating that to withstand the long fasting hours of summer Ramadans they tend to "[spend] time with [. . .] family at the mosque where they read from the Koran," to "read more of the Koran," to "[stay] busy helping out at home and being involved in [community programs]," and to "spend more time in active worship and prayer [to take their] mind off it." The impact is not felt only at higher latitudes, however, as exemplified by reports on challenging summer Ramadans in Egypt ("a fast to test all our willpower"; al Shalchi 2010) or Saudi Arabia (Mohammed 2013). More directly, the long hours also seem associated with a greater crowding out of work activities, as "the working day shortens by two or three hours" (*The Economist* 2010).

8. The Online Appendix provides descriptive statistics for all the variables used in the analysis.

9. Available at http://www.muslimphilosophy.com/ip/hijri.htm.

10. To keep things simple, we use a country's capital as the coordinates of interest, downloaded from http://www.cepii.fr/anglaisgraph/bdd/distances.htm. This obviously induces some measurement error in our data. Similarly, the Qur'an specifies that fasting should start at dawn (first light), whereas we measure the start exactly at sunrise, and this subtle difference may therefore introduce some minor measurement error. Moreover, in some Muslim societies fasting does not start until the new crescent moon of Ramadan has been sighted. Since these deviations are likely idiosyncratic, measurement error is likely to be classical and would lead to attenuation bias in our estimates. The sunrise and sunset patterns of Mecca are also sometimes followed, especially at very high latitudes, but this choice is evidently

We then match the data on Ramadan fasting hours with various data sets. For the Muslim share of a country's population, we use data from Version 1.1 of the World Religion Project (WRP) (Maoz and Henderson 2013), which contains information about the number of adherents in each of the states in the international system, for every half-decade period between 1945 and 2010. We generate a yearly panel via interpolation, for the years between WRP years, and extrapolation, for years after 2010 and before a country's independence.

Data on economic growth comes from the Penn World Tables 8.0 (PWT8.0) (Feenstra, Inklaar, and Timmer 2013), resulting in an unbalanced panel of 167 countries between 1950 and 2011. Our main outcome of interest comes from national-accounts data on real GDP growth per worker, in constant 2005 prices. (We also consider growth in real GDP and real GDP per capita, for robustness.) Since the variation in fasting hours that we use is at a yearly level, we focus on year-on-year growth.

To asses whether Ramadan affects SWB, we use data from all six waves of the World Values Survey (WVS). The surveys were conducted from 1981 to 2014 in 97 countries, totaling more than 330,000 interviews, of which about 72,000 are with individuals self-identifying as Muslim, living in 83 countries. We use the two key standard measures of SWB. First, "Feeling of Happiness" is a hedonic measure taken from the answer to the question: "Taking all things together, would you say you are: not at all happy, not very happy, quite happy, very happy?" We construct the standard indicator variable equal to 1 if the respondent answers "quite happy" or "very happy," and 0 otherwise. The second measure, "Life Satisfaction," is more evaluative, based on the question: "How satisfied are you with your life as a whole these days?" (on a numerical 10-point scale). We construct an indicator variable equal to 1 if the answer is above 5, and also present results using the raw number. The survey also contains information on beliefs and values, and measures of religious engagement, all of which we will describe as they enter our discussion.

endogenous and we thus leave it aside. Last, we could have used the total number of fasting hours required over a given year, but the difference would be absorbed by the year fixed effects, leaving our results unchanged.

III.B. Identification Strategy and Specifications

Our identification strategy exploits the fact that the number of daylight hours during Ramadan will vary differentially across countries over time, because the Islamic calendar follows the lunar cycle, with no leap years. There are two key factors that interact to give rise to arguably idiosyncratic and exogenous variation in Ramadan fasting hours. First, there is the timing of the start of Ramadan: in years when Ramadan is held during summer months, the sun is up for longer, and fasting hours as stipulated by the Qur'an increase accordingly. Second, the geographical location of the country, and more specifically its latitude, also matters: it is the primary determinant of sunrise and sunset times at any given date. During summer Ramadan the hours will be longer the further away from the Equator, whereas during winter Ramadan the relationship is reversed. As long as we control for year and country fixed effects, we automatically control for any possible independent effects of Ramadan timing and country latitude. We are then left with the variation due to the interaction of the two factors, and this is what we exploit.

To illustrate the nature of that variation, we first show, in Figure I, a map highlighting the countries in the PWT8.0 according to the share of Muslims in the population. We can see that there is substantial variation in latitude among countries with relatively large Muslim populations, in spite of there being none in very high latitudes.

Figure II illustrates the way latitude and timing interact in affecting stipulated fasting, to provide visual intuition for the variation we use for identification. It plots for every year the average daily fasting hours for three countries, Bangladesh, Indonesia, and Turkey. There is within-country variation over time, but most important is the fact that the time variation is different across the three countries. Compare first Bangladesh, which is roughly at the average latitude for the subsample of Muslim-majority countries, to Turkey, which has one of the highest latitudes in that sample. Bangladesh has shorter fasting hours when Ramadan falls during the Northern Hemisphere summer (as in the early 1950s and 1980s), and the opposite happens when it falls in the winter months (as in the mid-1960s or late 1990s/early 2000s). Indonesia in turn illustrates yet another source of idiosyncratic variation, coming from the fact that

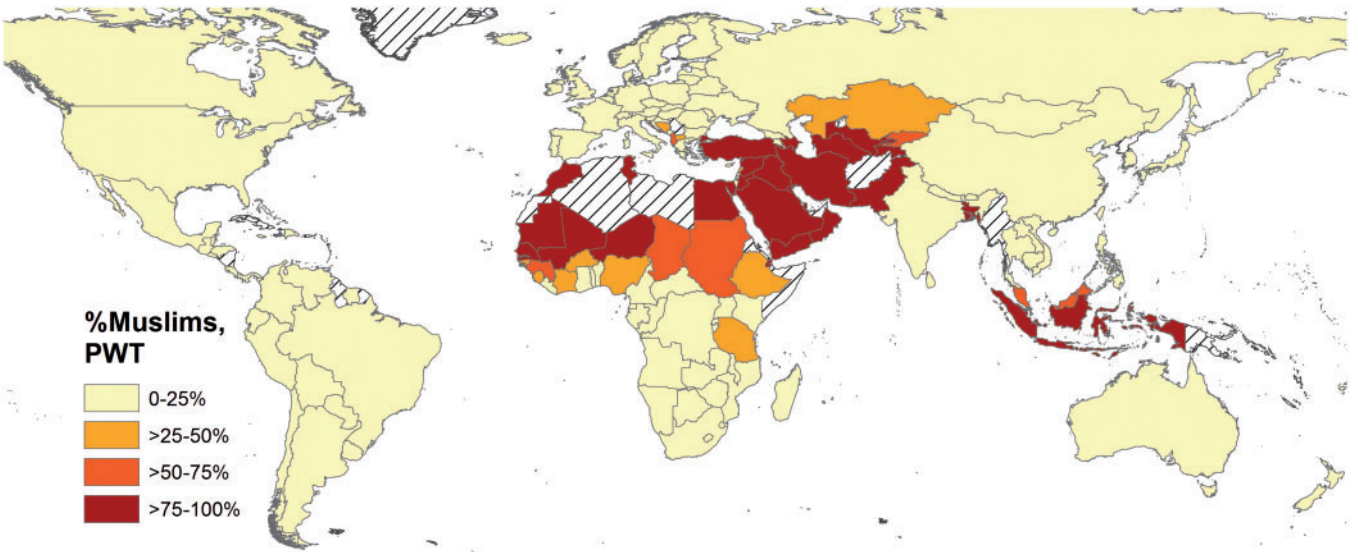

FIGURE I

Countries and Their Muslim Population Share (PWT8.0)

Hatched countries are not available in the PWT8.0 data set. The Muslim population share refers to the sample period mean, using data from the World Religion Project 1.1.

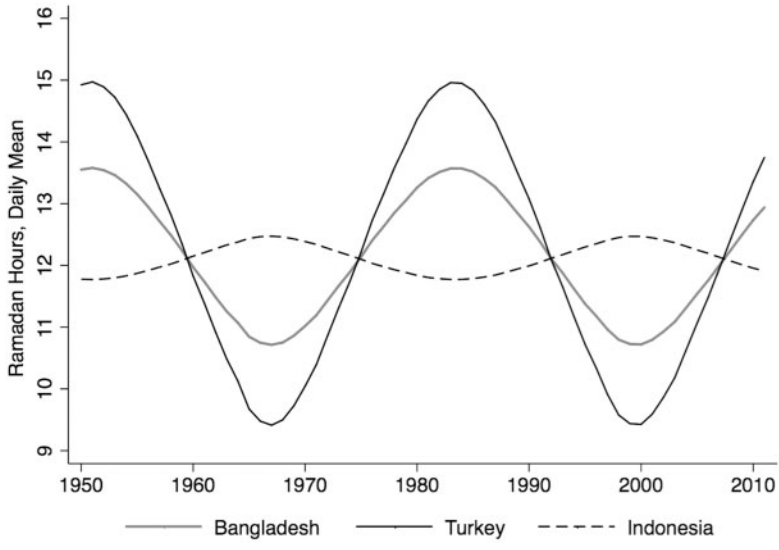

FIGURE II

Daily Ramadan Fasting Hours, Three Countries

Each line represents the average daily number of sunrise-to-sunset hours during the month of Ramadan in each year, measured in each country's capital.

seasons are reversed in the Southern Hemisphere.[11] Note also that the further from the Equator, the greater the amplitude of variation.

Finally, Figure III shows the implications when we take the sample of Muslim countries as a whole: the average daily length of Ramadan fasting fluctuates according to the Northern Hemisphere seasons, since that is where the vast majority of Muslim countries are, and the variation around the average (as measured by the lines marking the 20th and 80th percentiles of the hours distribution bands) peaks on December and June Ramadans.

We can implement this identification strategy by estimating the following equation:

$$g_{ct} = \beta * RamadanHours_{ct} + \delta_c + \mu_t + \varepsilon_{ct}, \quad (1)$$

11. Note that all curves cross when Ramadan falls around the vernal or autumnal equinoxes, when days and nights are of equal length.

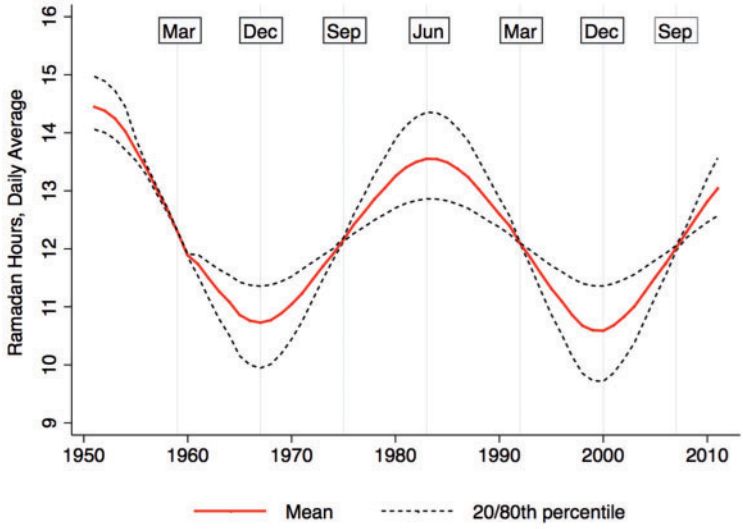

FIGURE III

Daily Ramadan Fasting Hours in Muslim Countries (PWT)

Each line represents the average daily number of sunrise-to-sunset hours during the month of Ramadan in each year, for different parts of the distribution among countries with at least 75% Muslim population share (29 countries, unbalanced panel). The solid line is the mean, while the dashed lines represent the 20th and 80th percentiles. The boxes at the top indicate which month Ramadan starts in. The graph shows that most of the within-year variation in fasting hours occurs during summer and winter Ramadan (June and December), while there is no variation when Ramadan is held in equinox months (March and September).

where g is an outcome (e.g., real GDP per worker growth) in country c in year t, *RamadanHours* is the logged average daily number of fasting hours during Ramadan, and δ and μ capture country and year fixed effects, respectively.[12]

The country fixed effects account for all time-invariant differences across countries, such as geography or cultural factors that do not vary over time. The year fixed effects in turn control for factors that vary across time but are constant across

12. We should stress that what we estimate, as indicated by equation (1), is the marginal effect of increasing the number of Ramadan fasting hours. We cannot estimate an effect against a counterfactual where Ramadan is absent—a linear extrapolation to zero hours would be patently absurd. In the Online Appendix we also show that the results are essentially identical when using hours in levels rather than logs.

countries, such as global business cycles or the time of the year when Ramadan happens to be held. Together, they let us focus on the idiosyncratic variation we have described.[13] We also present results controlling for linear country trends and population growth, although by assumption this would not be necessary since population growth is uncorrelated with Ramadan fasting hours. Still, this may reduce residual variation, leading to more precise estimates. We do not control for other economic factors because they may be endogenous to Ramadan fasting.

We would expect Ramadan fasting requirements to meaningfully affect economic growth only in countries that have a substantial share of Muslim population. For this reason, we estimate equation (1) in the subsample of countries with clear Muslim majorities. We define the subsample using the 75%-Muslim threshold, which we base on the average over the available period to obtain a balanced panel.[14]

To further probe how the effect varies with the relative size of the Muslim population, we also estimate an interaction specification over the entire sample:

$$g_{ct} = \beta(RamadanHours_{ct}) \times (Muslim_{ct}) + \lambda(RamadanHours_{ct}) + X_{ct}\gamma' + \delta_c + \mu_t + \varepsilon_{ct}, \quad (2)$$

where *Muslim* is the share of Muslims in the population, and X is a vector of covariates consisting of flexible controls of the Muslim population share, Muslim-by-year fixed effects which control for any yearly shocks that might differentially affect countries depending on the size of their Muslim population, and country trends. Again, if Ramadan fasting truly affects economic outcomes, we would expect $\lambda=0$, as no true aggregate effect should be detected when Muslims are a vanishingly small minority. Finally, since the effect of longer Ramadan may not be linear in

13. It is worth noting that there is meaningful residual variation in Ramadan fasting hours: the fixed effects account for 36% of the variation across all countries and years.

14. Specifically, using the average measure prevents countries that hover around the threshold from dropping in and out of the sample in different years. As an example, Senegal is recorded as having increased its Muslim share from about 73% in 1950 to about 83% in 1970 and up to 94% by 2010. Those early years would have been left out of the subsample, quite arbitrarily, if we were to use the variation over time; by using the time average (of about 84%), we make sure that all years are included. The results are robust to this alternative definition (available on request).

the Muslim population share, we also present results with flexible interactions.

When it comes to SWB, we can exploit the individual dimension of the survey data, with the following specification:

$$(3) \qquad y_{ict} = \beta * RamadanHours_{ict} + \delta_c + \mu_t + X_{ict}\gamma' + \varepsilon_{ict},$$

where subscript i denotes individual i living in country c surveyed in year t, and X_{ict} is a vector of demographic controls, again in the spirit of reducing residual variation and increasing precision.[15]

We estimate this equation on the sample of individuals who are presumably "treated" by Ramadan fasting: those who self-identify in the survey as Muslims. Of course, not all Muslims will fully comply with the formal fasting hours, and the choice of whether to do so is evidently endogenous.[16] Our estimates thus capture the reduced-form effects of formally prescribed fasting hours, including on those who choose not to comply as a result of that increase. Given that our primary interest is the average causal effect among Muslims of an increase in the strictness of the practice, part of which may operate precisely by inducing changes in compliance, these regressions will actually provide us with the desired estimates.

The focus on Muslim individuals, rather than countries, also means that we can actually use information from a broader set of countries. In particular, we now have additional variation in latitude at our disposal, as can be readily seen from Figure IV, depicting the size of samples coming from each country in the case of the latest wave of WVS (Wave 6).

Another important factor to keep in mind when interpreting our results is the timing of the survey. The actual dates of the interviews are only recorded in the data for Wave 6, and hence we cannot apply our empirical strategy: the only variation in Ramadan fasting hours we would have would be in the cross-section of countries and with a rather small sample. Not being able to use the specific timing, we define *RamadanHours* as the log number of fasting hours during the most recent Ramadan

15. The controls are gender dummy, second-order polynomial in age, marital status dummies, number of children, and education dummies.

16. According to survey evidence from Dinar Standard (2011), from five Muslim countries (Malaysia, Saudi Arabia, Egypt, Pakistan, United Arab Emirates) and five countries where Muslims are a minority (United States, United Kingdom, Canada, India, Australia), 98% of Muslims report fasting during Ramadan.

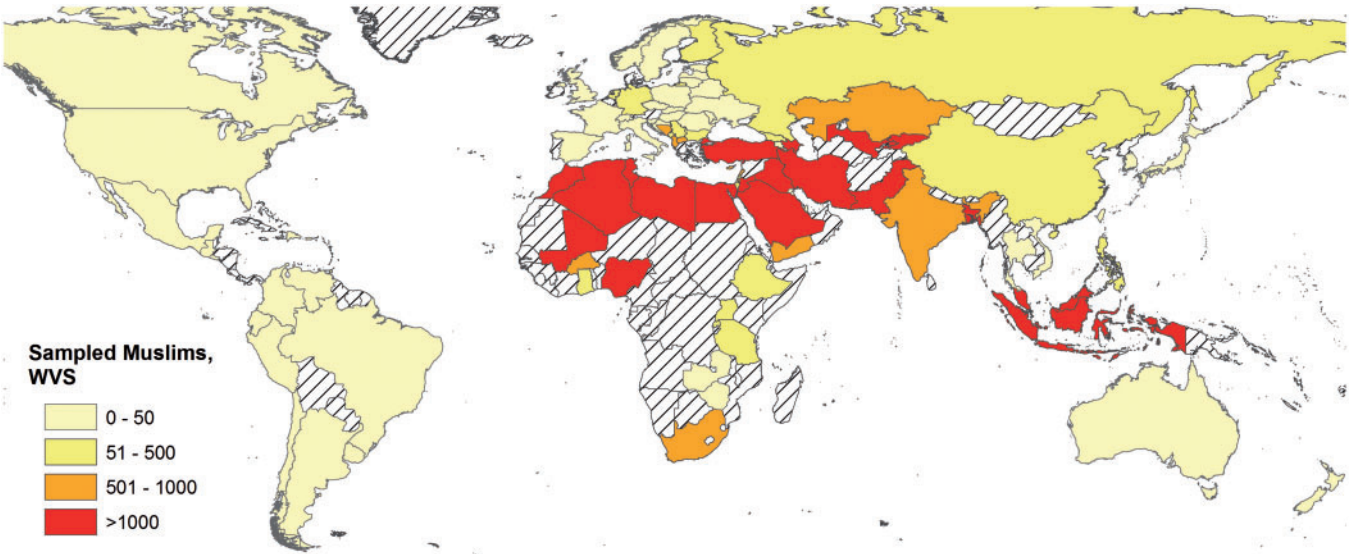

FIGURE IV

Surveyed Muslims (WVS)

The map shows the 83 countries with surveyed Muslims in the World Values Survey Wave 6 data set. Hatched countries are not available in the World Values Survey.

preceding the survey year.[17] It is safe to assume that the vast majority of the data points will lie outside of the month of Ramadan: in Wave 6, less than 1% of the Muslims in the sample were interviewed during Ramadan. It follows that our results should not be interpreted as pertaining to SWB during the holy month only.

Finally, we note that all of our specifications will report standard errors clustered at the country level to allow for the possibility that the error term might be correlated for different observations within a country—particularly since fasting hours vary smoothly from one year to the next. We also present, for robustness, results with two-way clustering by country and by year (Cameron, Gelbach, and Miller 2011).

IV. Basic Results

IV.A. Effects on Economic Growth

Table I presents the results on economic growth, starting with the subsample of Muslim countries. Column (1) shows a simple regression of real per worker GDP growth on (log) Ramadan fasting hours. The estimate is negative and statistically significant, implying that country-year pairs with long fasting hours tend to have on average lower growth rates. Column (2) then includes country fixed effects, to control for factors that affect growth and also covary with country latitude. We see a similar negative coefficient, implying that for a given country, years with summer Ramadan display on average lower growth. Column (3) includes year fixed effects instead, to control for growth determinants that also covary with the timing of Ramadan. Here the estimate implies that in any given year (and thus conditional on when Ramadan occurs), countries with longer fasting hours grow more slowly on average. The estimated coefficient is actually larger in magnitude, suggesting that focusing on the within-country variation—namely, the variation across seasons—if anything underestimates the true negative effect of stricter fasting.

Column (4) then displays our benchmark specification, as in equation (1), including both year and country fixed effects. The

17. The results are essentially identical if we use the hours in the survey year itself (results available on request).

TABLE I

THE EFFECTS ON ECONOMIC GROWTH IN MUSLIM COUNTRIES

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Real GDP per worker growth, constant 2005 prices							
Log(Ramadan hours)	−0.092***	−0.085**	−0.138***	−0.127***	−0.125***	−0.138***	−0.011	0.008
	(0.032)	(0.031)	(0.034)	(0.036)	(0.037)	(0.042)	(0.007)	(0.010)
Log(Ramadan hours) * %Muslim							−0.155***	
							(0.045)	
Log(Ramadan hours) * >0–25% Muslim								−0.023*
								(0.014)
Log(Ramadan hours) * >25–50% Muslim								−0.112*
								(0.065)
Log(Ramadan hours) * >50–75% Muslim								−0.193*
								(0.099)
Log(Ramadan hours) * >75% Muslim								−0.170***
								(0.045)
Observations	1,181	1,181	1,181	1,181	1,181	1,181	6,864	6,864
R-squared	0.01	0.07	0.09	0.14	0.19	0.27	0.25	0.25
Sample countries	Muslim	Muslim	Muslim	Muslim	Muslim	Muslim	All	All
Country FE	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Population control	No	No	No	No	Yes	Yes	Yes	Yes
Country trends	No	No	No	No	No	Yes	Yes	Yes
%Muslim-by-year FE	No	No	No	No	No	No	Yes	Yes
Standardized effect	−0.11	−0.10	−0.17	−0.15	−0.15	−0.17	N/A	N/A

Notes. Country-year panel data from Penn World Tables 8.0, 1950–2011. Ramadan hours is the average number of sunrise to sunset hours during the month of Ramadan, measured in the country's capital. In columns (1)–(6) the sample consists of the 29 countries with at least 75% muslims on average in the World Religion Project (WRP) database. In columns (7)–(8) all countries are included (162 countries), and the %Muslim variable is a yearly variable using interpolated WRP data. Population control is the yearly growth in population. %Muslim-by-year FE controls for the muslim population share bin dummies and their interactions with year dummies. Robust standard errors in parentheses, clustered at the country level. *** $p < .01$, ** $p < .05$, * $p < .1$.

estimate is again statistically significant ($\beta = -0.127$, $p = .002$), very similar in magnitude, and shows that Ramadan fasting has a negative effect on real per worker GDP growth. Column (5) shows that controlling for population growth does not affect the point estimate, and column (6) shows the same is true when we additionally control for linear country trends.

We then present the interaction specification, following equation (2), in column (7). The estimate on (log) Ramadan hours captures the estimated effect for a country where Muslims are a vanishingly small minority. Reassuringly, we find a coefficient that is very small and statistically insignificant, enhancing confidence in our empirical strategy. In contrast, the interaction coefficient shows that the effect of Ramadan fasting is present in countries with relatively large Muslim populations, with a magnitude that is consistent with the subsample estimates.

This specification imposes that the Muslim share of the population has a linear effect on the size of the impact of Ramadan fasting. It could very well be the case that the effect is nonlinear instead. To explore that possibility, column (8) implements a modified version of specification (2) in which we consider the possible heterogeneity of the effect across groups of countries with different levels of Muslim presence. Specifically, we estimate separate interaction coefficients between (log) Ramadan hours and dummies for whether a country falls within the 0%, 0–25%, 25–50%, 50–75%, or 75–100% ranges in terms of Muslim share of the population.

The results of this nnolinear specification can be seen graphically in Figure V, which depicts the implied coefficient on (log) Ramadan hours for each of the Muslim share bins, along with 95% confidence intervals. Once again, we find that the effect of Ramadan fasting in countries with small Muslim minorities (below 25%) is quite precisely estimated at around zero.[18] In contrast, we find a sizable and significantly negative effect exactly for the countries with at least 75% Muslim share, further underscoring our choice for the subsample threshold. We estimate a sizable coefficient for places with a smaller Muslim majority, but with

18. In light of this pattern, we take the 25% threshold as delimiting the "control group" in a series of placebo specifications reported in the Online Appendix. We find no significant effect across the board.

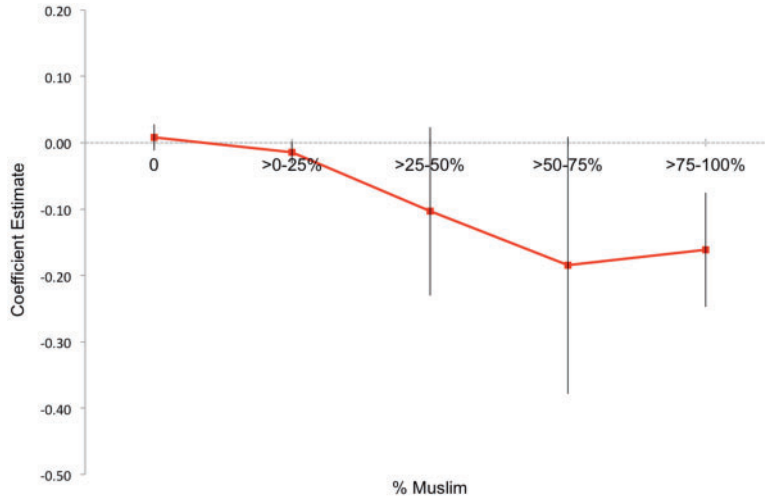

FIGURE V

The Effects of Ramadan Hours on Economic Growth, Nonlinear Estimates

The figure plots the estimated effects of longer Ramadan fasting hours, at different Muslim population shares. For each category, it is the linear combination of the main coefficient and the corresponding interaction coefficient in Table I, column (8). The vertical bars represent the 95% confidence intervals. The figure shows that longer Ramadan fasting hours have no significant effect on real GDP per worker growth in countries with small Muslim minorities, but a negative and statistically significant effect in countries with a large Muslim majority (>75%).

low precision most likely due to the relatively small number of countries within that range.[19]

Our results are robust to a wide variety of checks, which we report in the Online Appendix. First, the estimates are robust to two-way clustering of the standard errors, by country and by year. The estimates are also statistically significant when using a lower % Muslims sample inclusion threshold. The coefficient generally decreases in magnitude as the threshold is lowered, which is unsurprising given that countries where a smaller share of the population are fasting are gradually included. We then show that the results also hold when using growth in GDP

19. Only Albania, Brunei, Chad, and Sudan are in the 50–75% range for the entire sample period, with a handful of other countries being there for a subset of years.

levels or in GDP per capita as the measure of economic performance, though the coefficients are slightly smaller and less precisely estimated.

The results are not driven by outliers either, as we show visually in the Online Appendix by plotting the outcome residuals against log Ramadan hours residuals from the baseline specification. Alternatively, we also show that the results are unchanged when we drop each Muslim country from the sample, one at a time: the coefficients are very stable, and statistically significant. By the same token, the log specification does not seem to matter: the results are very similar in specifications with Ramadan fasting hours in levels.

Our next step is to consider the possibility that results could be somehow affected by convergence or mean reversion. To deal with that, we include lagged (log) GDP on the right-hand side of our specifications, to account for convergence. Since there are substantial econometric challenges in estimating the rate of convergence, especially in the presence of country fixed effects, we control for lagged income while imposing that it falls within the confines established by the growth literature (Barro 2012). Specifically, we allow for the rate of convergence to be right at the level of the "iron law of convergence" (2% a year) or at the lower and upper bounds (1.7% and 2.4%, respectively). In addition, following standard practice in the growth literature, we also collapse our data in blocks of five years (and also two, three, or four) so as to filter out noise in the yearly variation. In our case, the main variable of interest varies slowly and predictably over time, which is another reason to consider the results with the collapsed data.[20]

We show in the Online Appendix that the results are robust to different combinations of these procedures, both in the statistical significance and quantitative senses, as we can see by comparison with the baseline estimates that are reported in the first column. This includes specifications with the log of GDP per worker as the dependent variable, as opposed to the growth

20. To avoid needlessly throwing away relevant variation, we define the blocks so as to minimize the variation in fasting hours within them. We then average Ramadan hours over the period. We have checked the results for blocks of up to eight years, and they are robust. We do not report these results for the sake of keeping tables relatively uncluttered, but they are available on request.

rate, with and without the use of standard dynamic panel methods to account for persistence.

We also consider robustness to the possibility of terms of trade shocks. We control for measures of export and import prices (from the PWT8.0) to account comprehensively for the possibility that the evolution of terms of trade—encompassing commodity price shocks or similar developments—could confound our results. The results are indeed robust, with coefficient sizes again very much in line with our baseline results.

Another interesting question that we investigate in the Online Appendix is whether there is any asymmetry between the effects of longer Ramadan fasting hours in summer versus winter. It could be the case that the increase in strictness is more binding in summer months, when the hours get especially long and the heat makes fasting presumably more difficult. We check for that possibility by interacting Ramadan hours with a dummy for "summer" months—namely, the three months in the year with longest daylight hours: May–July in the Northern Hemisphere, and November–January in the South. We find that the interaction coefficient is insignificant and quite small once we control for country and year fixed effects. This suggests that there is little evidence for such asymmetric effects: an increase in fasting hours seems about as costly in the summer as in the rest of the year.[21]

In sum, we find robust evidence of a causal effect of longer Ramadan fasting on economic growth. Quite important, the estimated magnitudes are also robust and quantitatively meaningful. The last row in Table I shows that a 1 standard deviation increase (in the sample of Muslim countries) in Ramadan fasting hours, of roughly 10%, induces a decrease in economic growth of around one-sixth of a standard deviation.

21. More generally, the variation in Ramadan fasting hours could also be partly capturing the effect of temperature, as the latter is naturally correlated. This is not a problem as far as our analysis is concerned, since the effects of temperature would also constitute meaningful variation in the strictness of the fasting practice. Still, if we control for the countrywide typical average temperature in the month in which Ramadan starts, the coefficient on fasting hours remains very similar and statistically significant, while temperature has no significant effect. (These results are available on request.) This indicates that the increase in strictness associated with fasting hours per se, rather than due to temperature, is what is driving the results.

To translate these magnitudes into a more concrete example, consider the comparison between Bangladesh and Turkey. Our benchmark estimate from column (4) implies that the average per worker growth rate in Bangladesh at the height of the (Northern) summer Ramadan cycle would be just over 1 percentage point greater than that of Turkey. Turkey happens to have longer summer fasting hours by an amount roughly equal to 1 standard deviation of the variation experienced over the Ramadan cycle by the average Muslim country in our sample—which in fact corresponds roughly to the latitude of Bangladesh. (For the sake of comparison with the preexisting literature on religious practices and growth, Barro and McCleary 2003 find that a 1 standard deviation increase in monthly church attendance is associated with a decrease of about 1.1 percentage points in the growth rate.) In contrast, of course, growth in Bangladesh would be just over 1 percentage point lower than in Turkey over the winter Ramadan years. Although this symmetry implies that there is no divergence in performance over time, it is clear that our estimates imply a substantial economic cost stemming from more demanding Ramadan fasting.

IV.B. Effects on Subjective Well-Being

We now turn to the SWB results. Table II presents the results on the two key self-reported measures, happiness and life satisfaction. When estimating the effects on the first measure for all Muslims in the sample (columns (1) and (2)), the coefficients are positive and highly statistically significant ($p < .001$), indicating that Ramadan fasting increases measured SWB for Muslim individuals.

Columns (3) and (4) then estimate the effects separately for men and women. The coefficients are significant and positive for both sexes, with a point estimate of slightly larger magnitude for women. Column (5) in turn shows that the results are robust to running an ordered logit regression where the dependent variable is the four-category answer to the happiness question. Columns (6)–(10) then present the results for the same exercise, using life satisfaction as the dependent variable. We see results that are qualitatively very similar to those for happiness, though the effect is generally larger from a quantitative perspective.

The results are robust to two-way clustering of the standard errors and controls for country-specific trends, as shown in the

TABLE II

THE EFFECTS ON SUBJECTIVE WELL-BEING AMONG MUSLIMS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Happiness						Life satisfaction					
	Dummy	Dummy	Dummy	Dummy	Dummy	Likert, ologit	Dummy	Dummy	Dummy	Dummy	Dummy	10p scale
Log (Ramadan hours)	0.54*** (0.11)	0.52*** (0.11)	0.41*** (0.09)	0.45*** (0.09)	0.37*** (0.11)	1.95*** (0.49)	1.47*** (0.19)	1.44*** (0.19)	1.25*** (0.199)	1.35*** (0.22)	1.18*** (0.18)	6.03*** (0.78)
Observations	71,256	69,959	69,959	35,051	34,908	69,959	70,510	69,254	69,254	34,656	34,598	69,254
R-squared	0.08	0.10	0.12	0.13	0.13	0.07	0.10	0.12	0.16	0.16	0.16	0.17
Sample gender	Both	Both	Both	Female	Male	Both	Both	Both	Both	Female	Male	Both
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Baseline controls	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Additional controls	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Standardized effect	0.17	0.16	0.14	0.15	0.13	N/A	0.37	0.37	0.35	0.34	0.37	0.32

Notes. Individual-level outcome data from the World Values Survey, 1981–2014. All individuals in the sample are Muslims. Ramadan hours is the average number of sunrise to sunset hours during the month of Ramadan in the year preceding the survey. Happiness is the answer to the question: "Taking all things together, would you say you are: not at all happy, not very happy, quite happy, very happy?", where the dummy is equal to 1 if the respondent feels "quite happy" or "very happy." In column (6) the dependent variable consists of the four Likert categories, and the coefficient is estimated using ordered logit. Life satisfaction is the answer to "How satisfied are you with your life as a whole these days?," on a numerical 10-point scale, where the the dummy variable indicates a value above five. In column (12) the raw number is the dependent variable. The baseline controls are age, age squared, number of children, marital status dummies, education level dummies, and a gender dummy. The additional controls are dummies for social class (upper class, upper middle class, lower middle class, working class, lower class), income class (10 steps), and population size of town of residence (eight categories). Robust standard errors in parentheses, clustered at the country level. *** $p < .01$, ** $p < .05$, * $p < .1$.

Online Appendix. We also show there that the estimates are not driven by outlier observations or individual countries and that the results are essentially the same if we use Ramadan fasting hours in levels rather than logs.

As an alternative to the individual-level variation, and since the variation in Ramadan fasting hours is at the country level, we also aggregate the data up to that level. In other words, we compute the average value of the SWB measures, and run specifications analogous to equations (1) and (2). In the former case, we take the average over the subsample of Muslim (or non-Muslim) individuals; in the latter case, we take it over the entire sample. In the Online Appendix we show that the results are robust to this specification: a significant positive effect is present only for the average SWB of Muslim individuals.

The quantitative implications of the SWB results are also meaningful, as was the case with GDP. The estimates imply that our aforementioned thought experiment comparing Bangladesh and Turkey would imply that in summer Ramadans, Turkish Muslims would be about 5 percentage points likelier to report they are happy. This corresponds to a standardized effect of about 0.15 that is similar to what we found for GDP.

In short, and keeping in mind that the vast majority of our survey respondents were not being interviewed during the holy month, our results mean that Muslims report feeling significantly happier and more satisfied with their lives after Ramadans with long required fasting hours, even though Ramadan fasting has an important material cost in Muslim countries.

V. Discussion

Our central results are very clear. First, longer Ramadan fasting has a robust, statistically significant, and quantitatively important negative effect on economic growth in Muslim countries. This is very much in line with the correlation patterns previously found in the literature that has looked at the links between religious practices and economic growth, and quantitatively our estimates imply an effect of religious practices that is about the size found, for instance, in Barro and McCleary (2003).

Second, longer Ramadan fasting has a robust, statistically significant, and quantitatively important positive effect on SWB

reported by Muslim individuals. This seems consistent with the extant literature on religion and happiness, but is in fact in tension with the previous result on growth: since what we measure is a net effect on SWB, our evidence indicates that Muslims are happier in spite of being poorer. Any negative effect of reduced GDP growth and material living standards on SWB is therefore trumped by the nonpecuniary benefits of a longer or more intense prescribed religious practice.

The key remaining question is how we can understand the underlying mechanisms driving these results, especially what explains the diverging effects on economic performance and SWB.

V.A. Costly Religious Practices

A natural explanation starts from the celebrated model of religious activity as a club good, put forth by Iannaccone (1992) to explain the emergence and persistence of economically costly religious practices. Although that model has most often been applied to understand the behavior of relatively smaller nonmainstream religious groups ("sects," in standard sociological parlance) (e.g., Iannaccone 1994; Berman 2000), the logic can naturally be applied to an example of a widespread religious practice, such as those associated with Ramadan fasting, that is both costly and largely visible.

The key idea is that the utility an individual derives from her religious activities is increasing in the engagement of her fellow worshipers. This club good feature gives rise to a standard free-riding problem, and hence to underprovision of the religious activity, from the perspective of the group, because individuals fail to take into account the benefit that their engagement provides to the other members.

As a result, increasing the strictness and cost of the practices associated with a religious group can improve the welfare of its members in two ways. First, it may increase the relative cost of engaging in activities outside the group. In the example of Ramadan, the fasting itself means that it is harder to socialize with noncompliers—since many opportunities for socializing naturally involve food and drink—and the other activities associated with the holy month (*tarawih* prayers, *iftar* meals, and so on) take up time that thus cannot be used to be around one's non-Muslim friends or acquaintances. Because of that, under certain

conditions, increasing the strictness of the practices required from group membership will increase the welfare of group members (Iannaccone 1992, Proposition 1).

Second, but just as important, strict practices work as a screening device to keep out relatively less committed members or potential members. If individuals are heterogeneous with respect to their preferences regarding religious activity, then as long as those who are less inclined to participate are sufficiently numerous, there will be a separating equilibrium in which the more committed sort into a group that requires strict sacrifices from their members, while the less committed sort out into less demanding groups (Iannaccone 1992, Proposition 2).

The combination of these forces naturally fits the general pattern established by our basic results: increasing the strictness of fasting requirements is economically costly, as demonstrated by the impact on economic performance, but can nevertheless be associated with increased SWB.[22] Most important, the framework generates testable predictions that we can take to the data to assess the empirical content of this explanation for the basic results.

Membership and Engagement. We first check the impact of increased fasting requirements on patterns of membership in religious groups. The WVS lists several types of voluntary organizations, one of which is "church or religious organization," and asks the respondent whether she is an "active member," an "inactive member," or "not a member" of organizations of each of those types. We code dummy variables equal to 1 if the individual describes herself as an active member of the corresponding type.

Table III displays the results. Columns (1) and (2) show that longer Ramadan hours have a negative effect on active membership of religious organizations, with and without controlling for individual demographic characteristics.[23] Quantitatively, the standardized effect is about 0.15, again of the same order as the

22. In this we are implicitly assuming that measures of reported SWB are indicative of or at least a proxy for welfare in a broader sense. For a discussion of the extent to which those measures relate to welfare, see Benjamin et al. (2012).

23. Those characteristics are age, age squared, number of children, marital status dummies, education level dummies, and a gender dummy, plus income, social class, and size of town dummies.

TABLE III
THE EFFECTS ON MEMBERSHIP IN RELIGIOUS AND NONRELIGIOUS ORGANIZATIONS

	(1)	(2)	(3)	(4)	(5)	(6)
	Mosque or other religious organization		Nonreligious organization		Any organization	
Log(Ramadan hours)	−0.463***	−0.530***	0.423*	0.443**	−0.158	−0.204
	(0.127)	(0.119)	(0.216)	(0.181)	(0.178)	(0.137)
Observations	43,777	42,904	42,771	42,078	43,056	42,330
R-squared	0.26	0.27	0.11	0.17	0.22	0.25
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Baseline controls	No	Yes	No	Yes	No	Yes
Additional controls	No	Yes	No	Yes	No	Yes
Standardized effect	−0.14	−0.16	0.11	0.11	−0.04	−0.05

Notes. Individual-level outcome data from the World Values Survey, 1981–2014. All individuals in the sample are Muslims, from all countries in the data. The dependent variables are dummies, indicating active membership in a religious organization (columns (1)–(2)), nonreligious organization (columns (3)–(4)), or any organization (columns (5)–(6)). Ramadan hours is the average number of sunrise to sunset hours during the month of Ramadan in the year preceding the survey, in the country's capital. The baseline controls are age, age squared, number of children, marital status dummies, education level dummies, and a gender dummy. The additional controls are dummies for social class (upper class, upper middle class, lower middle class, working class, lower class), income class (10 steps), and population size of town of residence (eight categories). Robust standard errors in parentheses, clustered at the country level. *** $p < .01$, ** $p < .05$, * $p < .1$.

results for GDP and SWB. Columns (3) and (4) in turn show that this behavior is mirrored by an increase in membership of nonreligious organizations, essentially of the same magnitude, such that the likelihood of being an active member of an organization of any kind is unaffected (columns (5) and (6)).[24]

In other words, increasing the strictness of the Ramadan fasting requirement reduces membership of Muslim individuals in religious groups and induces a corresponding increase in membership of other kinds of organizations. This is exactly what one would expect when a costly religious practice works as a screening device.

We can further explore the nature of the response by considering the evidence on religious engagement, as measured by frequency of attendance at religious services, in Table IV.[25]

24. "Nonreligious organizations" encompass a broad variety of types: sport or recreational; art, music, or educational; labor unions; political parties; environmental; professional; humanitarian or charitable; consumer; self-help or mutual aid; plus other.

25. The question as reported in the WVS questionnaire is "Apart from weddings, funerals and christenings, about how often do you attend religious services

TABLE IV

THE EFFECTS ON ATTENDANCE AT RELIGIOUS SERVICES

	(1) ≥Monthly	(2) >Weekly	(3) Likert	(4) ≥Monthly	(5) >Weekly	(6) Likert
Log(Ramadan hours)	−0.417	−0.067	0.356	−0.754***	−0.249	−0.901
	(0.252)	(0.356)	(1.722)	(0.276)	(0.336)	(1.60)
Log(Ramadan hours) * Religious commitment, med.				0.595**	0.440**	2.90**
				(0.232)	(0.170)	(0.97)
Log(Ramadan hours) * Religious commitment, high				1.224***	0.897***	5.71***
				(0.338)	(0.275)	(1.59)
Observations	66,254	66,254	66,254	66,254	66,254	66,254
R-squared	0.25	0.25	0.24	0.25	0.26	0.10
Regression type	OLS	OLS	O-Logit	OLS	OLS	O-Logit
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes
Additional controls	Yes	Yes	Yes	Yes	Yes	Yes
Religious commitment dummies	No	No	No	Yes	Yes	Yes
Standardized effect	−0.11	−0.02	N/A	N/A	N/A	N/A

Notes. Individual-level outcome data from the World Values Survey, 1981–2014. All individuals in the sample are Muslims, from all countries in the data. Ramadan hours is the average number of sunrise to sunset hours during the month of Ramadan in the year preceding the survey, in the country's capital. The dependent variables are based on the question "Apart from weddings, funerals and christenings, about how often do you attend religious services these days?" In column (1) a dummy indicates at least once a month, in column (2) more than once a week, and in column (3) the outcome is a Likert scale (more than once a week, once a week, once a month, only on holy days, once a year, less than once a year) where the regression is an ordered logit. Religious commitment is taking the first principal component of active membership in religious organizations, nonreligious organizations, and attendance at mosques, and predicts the first principal component in a regression on all the demographic controls, Muslim population share, country fixed effects, and year fixed effects. All individuals demographic controls have predictive power of the first principal component. High commitment indicates the predicted top tertile in the sample, medium commitment the middle tertile, and the bottom tertile is the omitted category. Regressions in columns (4)–(6) include decile dummies of the predicted religious commitment. The baseline demographic controls are age, age squared, number of children, marital status dummies, education level dummies, and a gender dummy. The additional demographic controls are dummies for social class (upper class, upper middle class, lower middle class, working class, lower class), income class (10 steps), and population size of town of residence (eight categories). Robust standard errors in parentheses, clustered at the country level. *** $p < .01$, ** $p < .05$, * $p < .1$.

Columns (1)–(3) show no significant effect of increased Ramadan fasting on attendance, whether measured by a dummy equal to 1 if the individual attends religious services at least once a month, a dummy for attendance more than once a week, or an attendance Likert scale.

This may look at odds with the negative effect on membership, but in fact the club good framework would lead us to expect a heterogeneous pattern, according to the degree of commitment that one might expect from each individual. Specifically, the framework would naturally predict that the individuals who are screened by the costly practice will reduce their engagement. In contrast, it predicts that those who remain committed to the group may actually increase their engagement with in-group activities, as the reduction in free-riding will make participation more appealing.[26]

In the Iannaccone (1992) model, the heterogeneity is driven by individual preferences for religious versus nonreligious activities, which in turn make them more of less committed to the religious "club." To capture these deep preferences in our data, we exploit a principal component analysis of active membership in religious organizations, nonreligious organization, and attendance at mosques. To avoid the obvious issue that this measure of commitment is based on endogenous decisions, we instead use the predicted value of the first principal component from a regression on individual demographic characteristics (plus Muslim population share, and country and year fixed effects). We then split the sample into three terciles, which we refer to as "high-commitment," "medium-commitment," and "low-commitment" individuals, and consider whether the absence of an average effect is indeed masking heterogeneity across these different groups.

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these days?" It offers eight possible responses on a Likert scale: "More than once a week," "Once a week," "Once a month," "Only on special holy days/Christmas/Easter days," "Other specific holy days," "Once a year," "Less often," "Never/practically never." It is worth noting that there are some differences across countries in the way the question is translated and asked. For instance, while in Morocco or Turkey the question asks specifically about mosque attendance, in Indonesia the translation speaks of "practicing religious traditions" (Fish 2011, p. 41). To the extent that these differences lead to differences in the scaling of participation, they will be absorbed by the country fixed effects.

26. In Iannaccone's words: "Levels of participation and levels of 'sacrifice' demanded by religious groups will be correlated" (Iannaccone, 1992, p. 285).

Column (4) in Table IV shows a negative main effect of fasting hours, which, since the low-commitment dummy interaction is omitted, means that those individuals who are predicted to be less committed actually reduce their likelihood of attending a mosque at least once a month. Column (5) then turns to the higher end of the attendance spectrum, considering at least weekly attendance. Here we see a main effect of strictness that is relatively small and statistically insignificant, in contrast with significantly positive coefficients for the interactions with the high and medium commitment dummies. The absence of an effect for low-commitment individuals is rather unsurprising given that those individuals were relatively unlikely to go the mosque that often in the first place. The interaction effects, in contrast, suggest that those who are predicted to be more committed increase their relative level of attendance as a result of the increased strictness. In short, the individuals who are more likely to be committed to religious groups increase their mosque attendance compared with those who are least likely to be committed.[27]

Column (6) shows the ordered logit results for a Likert scale of attendance responses, with similar results. In this case, for the group with high commitment, we can further reject that the sum of main coefficient and interaction coefficient is zero, suggesting an absolute increase in engagement for the more committed individuals.

In sum, the absence of an average effect on attendance masks a heterogeneous impact of the increased strictness of Ramadan fasting according to the degree of predicted religious commitment. The evidence is thus consistent with a picture in which the stricter fasting requirement induces less committed individuals to disengage with religious activity.[28] The more committed, in contrast, do not decrease their participation in religious

27. As it happens, and unsurprisingly, the latter are exactly the ones who are more likely to become members of other kinds of voluntary organizations, in response to increased fasting requirements (available on request).

28. Note that this mechanism is not predicated on the idea that less committed individuals stop fasting when the requirement becomes more burdensome. For instance, it could be the case that they still fast, but become less inclined to go to the mosque for *tarawih* prayers in the evening—perhaps feeling that the increased fasting and reduced sleep hours are already enough—and this in turn has a persistent effect on mosque attendance.

TABLE V
THE EFFECTS ON BELIEFS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Religious beliefs								
	God	Heaven	Hell	Afterlife	Soul	Average beliefs	Generalized trust, dummy		
Log(Ramadan hours)	−0.024	−0.049	−0.123	−0.220	0.027	0.012	−0.45**	−0.44**	−0.43***
	(0.058)	(0.103)	(0.241)	(0.144)	(0.069)	(0.120)	(0.17)	(0.17)	(0.14)
Observations	47,896	29,608	47,196	29,589	29,736	29,139	68,625	67,385	67,385
R-squared	0.06	0.28	0.23	0.29	0.17	0.31	0.11	0.11	0.12
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Additional controls	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Standardized effect	−0.03	−0.01	−0.06	−0.05	0.01	0.01	−0.13	−0.13	−0.12

Notes. Individual-level outcome data from the World Values Survey, 1981–2014. All individuals in the sample are Muslims, from all countries in the data. Ramadan hours is the average number of sunrise to sunset hours during the month of Ramadan in the year preceding the survey, in the country's capital. The dependent variables are: in columns (1)–(5) dummies indicating if the answer is yes to the question "Which, if any, of the following do you believe in?" and 0 otherwise (No or Don't Know); in column (6) the average value of the variables across the variables (God, Heaven, Hell, Afterlife, People Have a Soul). In columns (7)–(9), the outcome is a dummy indicating a positive answer to the question "Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?" The baseline controls are age, age squared, number of children, marital status dummies, education level dummies, and a gender dummy. The additional controls are dummies for social class (upper class, upper middle class, lower middle class, working class, lower class), income class (10 steps), and population size of town of residence (eight categories). Robust standard errors in parentheses, clustered at the country level. *** $p < .01$, ** $p < .05$, * $p < .1$.

activities and may actually increase it, just as we would expect from the club good framework.[29]

Beliefs. We can also ask whether the changing patterns of religious engagement that we have documented induce changes in individual beliefs. This is a question that is very natural, as we can conceptualize religious activities as an input in the production of beliefs, as well as important from an economic perspective, as many of these can have implications for economic behavior and outcomes (Barro and McCleary 2003).

We present the results in Table V. A natural starting point is to look at the specifically religious domain, about which we can also find information in the WVS. Columns (1)–(5) display the results for a set of such questions, ranging from belief in God to belief in heaven. We find no evidence of an effect of increased Ramadan fasting requirements over the prevalence of any of these religious beliefs, nor on the average over the different kinds (column (6)). Given that these beliefs are very strong among Muslims—for instance, in the WVS 99% report to believe in God, and 92% reportedly believe in heaven—the absence of significant effects of increased strictness is arguably rather unsurprising.

However, religious beliefs are not the only domain affected by the practice of organized religion. In fact, a large part of the impact of membership in religious organizations and engagement in religious activities may be associated with religious socialization and its effects on the formation of beliefs (Putnam and Campbell 2010). We thus look at WVS responses regarding a central kind of belief that has been widely studied in connection with socialization and social capital: generalized trust (e.g., Putnam 1995). This is captured by the standard question ("Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?"), and we code a dummy taking the value of 1 if the answer is "Most people can be trusted," as opposed to "Can't be too careful."

29. We find a positive effect of increased strictness on SWB across all categories of religious commitment (available on request). We may thus speculate that the increase in SWB could partly be the result of the reduced free-riding problem among practicing religious individuals, and perhaps of a better match in which those less inclined to take part in religious activities sort themselves into less demanding groups.

Columns (7)–(9) in Table V show that longer Ramadan fasting actually has a significant negative effect on generalized trust, with and without the different sets of demographic controls. The estimate is of a similar magnitude of the one for membership in religious organizations (Table III). This result is particularly interesting since, when it comes to socialization, our evidence has suggested that the individuals who left religious organizations as a result of the increased strictness largely joined nonreligious "clubs" instead. This would seem reassuring from the standpoint of overall levels of social capital, as the propensity toward civic engagement in voluntary organizations is largely unaltered. This conclusion, however, would rely on assuming that different types of organizations are essentially interchangeable in their ability to generate the kinds of things we associate with social capital.

Although we cannot rule out other possible mechanisms, such as a direct effect of lower GDP growth on trust, our findings are instead consistent with the possibility that religious organizations may be more effective in producing generalized trust.[30] That being the case, the screening role played by costly practices in that sense may have a negative side effect on generalized trust, to the extent that those driven away by those practices may then select into groups that are less effective in that regard.

In sum, we find evidence that the increased strictness of fasting requirements has an effect on beliefs and attitudes, not so much in the strictly religious domain, but likely as a result of their impact on patterns of socialization.

V.B. Productivity and Labor Supply

Besides the nature of the effects of costly religious practices, a related issue is what exactly lies behind the economic costs of the increased fasting requirements. In short, the question is whether the effects on economic growth stem from the impact of Ramadan on productivity or on input supply decisions.

30. This is consistent with the empirical literature that has found a positive correlation between religiosity and trust (e.g. Guiso, Sapienza and Zingales 2003; Putnam and Campbell 2010). It also relates to the long tradition linking religion and the emergence of intra-group trust (e.g. Sosis 2005), though in our case it is not obvious how we should define the relevant groups in that regard – Muslims vs non-Muslims, observant vs non-observant, etc.

Broadly speaking, when it comes to inputs, religious practices impose an immediate trade-off, to the extent that they require time and resources that are then unavailable for producing output. Going to the temple or on pilgrimages, taking time to pray or meditate or to study sacred books, spending money on religious rituals will all take away from what is devoted to (materially) productive work. Similarly, those practices could affect productivity as well: from facilitating or limiting social interactions with correligionists and outsiders (Iannaccone 1992) to purely physiological effects (e.g., dietary restrictions).

In the case of Ramadan, we have argued that the holy month involves a number of activities that evidently fit that pattern of competing for time and resources, thereby potentially affecting input supply. By the same token, there are physiological costs associated with fasting. Although this could be mitigated by a positive effect on productivity arising from increased networking and socializing, it is natural to posit that more intense Ramadan fasting would have a negative direct impact on labor productivity. Both channels would explain a negative effect of more intense fasting on economic activity during the month of Ramadan itself, consistent with the anecdotal perception of a general slowdown.

This immediate impact of Ramadan could in and of itself explain the negative effect on yearly GDP growth numbers. It would at the very least suggest that individuals fail to fully compensate for a month of especially intense Ramadan fasting by increasing economic activity over the rest of the year, in spite of the fact that the variation in Ramadan fasting hours is entirely predictable.[31]

Still, it could well be the case that the intensity of Ramadan fasting entails longer-lasting effects that spill over beyond the month, presumably through the impact of the religious practice (or the experiences associate with it) on preferences, beliefs, and values that may affect economic decisions (Barro and McCleary 2003). This impact, of course, could operate via input supply decisions, productivity, or both.

31. Higher-frequency data—for instance, quarterly data on industrial production, from the Internatonal Financial Statistics—clearly show a drop in production for Ramadan quarters, with some evidence of a rebound in the quarter that follows. Unfortunately, there are very few Muslim-majority countries in the data set, and the variation is not enough to pick up effects of Ramadan hours at that frequency.

Employment, Wages, and Preferences. To make progress in distinguishing between the productivity and input supply channels, we resort to their distinct implications when it comes to labor markets.[32] The labor supply mechanism would obviously represent a movement of the labor supply curve, as individuals choose to work less to the benefit of religious engagement. The productivity mechanism would in turn operate via labor demand, as a decrease in the marginal productivity of labor. Basic economic theory then leads us to expect the first channel to be associated with slower employment growth but faster wage growth, whereas the second channel would imply the former but not the latter.

For that we turn to the yearly data on wages and employment in the manufacturing sector, from INDSTAT2 2013 edition, which covers the 1963–2008 period.[33] The data are arranged at the two-digit level of the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 3, pertaining to the manufacturing sector, which comprises 23 industries. The data are based on surveys of establishments with at least 5–10 employees (the cut-off varies by country). It includes the total number of persons employed in each sector and the wages paid to those persons.[34] Since our variation in Ramadan hours is at the country-year level, we aggregate the sector data to the country-year level, resulting in an unbalanced panel data set with 130 countries, on employment (number of workers) and wage (annual wages per worker) growth.[35]

32. Obviously, religious practices could also affect the long-run accumulation of capital, of both the physical and human varieties. We will leave these aside, since our empirical strategy focuses on short- to medium-run variation. Within this horizon, it makes sense to take the capital stock as essentially fixed and instead focus attention on what happens to the supply and demand of labor. In addition, the Online Appendix shows evidence that the yearly growth rate of the capital stock does not seem to be affected by Ramadan fasting hours.

33. Version 8.0 of the Penn World Tables contains, for the first time, data on employment. However, the data for Africa and the Middle East is actually refering to the labor force, thus conflating the employed and the unemployed (Inklaar and Timmer 2013) and rendering it inappropriate for our purposes.

34. The wage data are made up of all payments paid to employees each year, including bonuses and housing allowances.

35. The data for Azerbaijan in 1992 shows an arguably implausible wage growth of more than 2,500%, or about 1,200 standard deviations above the mean. We exclude this observation as it is an extreme outlier.

TABLE VI

THE EFFECTS ON EMPLOYMENT AND WAGE GROWTH IN MUSLIM COUNTRIES

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Employment growth, number of workers				Wage growth, average wages			
Sample countries	Muslim	Muslim	All	All	Muslim	Muslim	All	All
Log(Ramadan hours)	−0.181	−0.187*	−0.004	−0.007	0.447**	0.521*	0.034	0.018
	(0.117)	(0.107)	(0.018)	(0.019)	(0.184)	(0.257)	(0.024)	(0.025)
Log(Ramadan hours) * Muslim country			−0.176*				0.486**	
			(0.104)				(0.242)	
Log(Ramadan hours) * %Muslim				−0.106				0.479**
				(0.134)				(0.241)
Observations	551	551	3,224	3,224	551	551	3,224	3,224
R-squared	0.21	0.28	0.24	0.28	0.22	0.26	0.23	0.30
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Population control	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Country trends	No	Yes	Yes	Yes	No	Yes	Yes	Yes
%Muslim-by-year FE	No	No	Yes	Yes	No	No	Yes	Yes
Standardized effect	−0.15	−0.16	−0.15	−0.09	0.23	0.27	0.25	0.25

Note: Country-year unbalanced panel data on employment and average wages from UNIDO INDSTAT manufacturing data set, 1963–2010. All independent variables are defined as in Table I. The full sample consists of 130 countries, of which 25 are Muslim countries (>75% Muslim). The standardized effects are calculated for Muslim countries (in columns (4) and (8) they refer to the predicted effect when the Muslim population share is 100%). Standard errors clustered at the country level. *** $p < .01$, ** $p < .05$, * $p < .1$.

The first four columns in Table VI report results on employment growth, where we find relatively weak evidence of a negative effect. Columns (5)–(8) in turn present estimates on the evolution of wages in the manufacturing sector. The point estimates are similar across specifications, statistically significant, and show a positive effect on wage growth.

These results are subject to a number of limitations. For instance, the restriction to manufacturing and relatively large firms is bound to provide a very incomplete picture of labor markets, especially since in the developing world, to which most Muslim countries can be ascribed, the manufacturing sector is rather disproportionately concentrated in the relatively small formal sector. That said, this evidence suggests that decreases in productivity are unlikely to be the whole story behind the negative effect on economic growth.

While the negative shock to labor supply would likely be at least partly related to the short-term effect from Ramadan competing with work activities, we also find evidence that changes in values and preferences could push in that direction as well. We show in the Online Appendix that longer Ramadan hours lead individuals to be less likely to report that work is more important than religion or leisure, for that matter.

In spite of these results, and regardless of their limitations, it is clear that lower productivity can also be a partial explanation for the effects we find. That said, the evidence does suggest that the impact of Ramadan fasting on productivity goes beyond immediate physiological consequences. In particular, the results regarding the effects on generalized trust provide direct evidence of relevant beliefs and attitudes being affected. These could help us understand the impact of increased Ramadan fasting beyond the holy month, especially in light of the evidence linking trust and economic performance (e.g., La Porta et al. 1997; Knack and Keefer 2007; Algan and Cahuc 2010; Tabellini 2010), as well as factors specifically related with productivity, such as the extent of cooperation and trade (e.g., Tabellini 2008; Guiso, Sapienza, and Zingales 2009).

VI. Concluding Remarks

Using idiosyncratic variation induced by the rotating Islamic calendar and its interaction with country latitude, we established

causal evidence for a negative effect of the length of Ramadan fasting requirement on economic growth in Muslim countries. We also established that this is accompanied by increased levels of self-reported happiness and life satisfaction among Muslims. We argued that these results can be interpreted using the standard club good model of costly religious practices (Iannaccone 1992), and showed evidence consistent with the predictions of that model. Finally, we discussed the possible channels through which an increase in fasting requirements affect economic performance, such as productivity and labor supply decisions. In particular, we have shown an impact on beliefs, such as regarding generalized trust, underscoring the point that the effects we find go beyond what happens during the holy month itself.

It seems natural to speculate that similar effects could be detected for other types of costly religious practices, as suggested by the way our results fit with the standard model. Obviously, our estimates cannot be directly extrapolated to other practices—Islamic or non-Islamic—but given that many of them share common elements, as possible devices for screening and preventing free-riding, it seems reasonable to expect that they could put in motion similar mechanisms to the ones our evidence highlights. This is a natural question for future research.

Last but not least, our article provides some new insights for the ongoing debate regarding how to assess the effects of policy interventions on welfare. Our results identify circumstances in which GDP growth and SWB are pushed in different directions, and in so doing they substantiate calls for considering measures of SWB as important indicators, in addition to standard measures such as GDP (Stiglitz, Sen, and Fitoussi 2009).[36]

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SUPPLEMENTARY MATERIAL

An Online Appendix for this article can be found at QJE online (qje.oxfordjournal.org).

36. An example finding a similar disconnect between income and SWB, in a very different context, can be found in Dorsett and Oswald (2014).

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