Online Appendix A: Formal Model of Religious Participation and Social Conservatism

In this Appendix, we detail the formal model from which the text's propositions are derived. We also prove these propositions. In specifying the formal model, we first summarize its components. We then expand upon the verbal description of the model provided in the text. This expanded verbal description of the model can be skipped if the self-contained model summary is considered sufficient.

Model Description

- **Actors:** An infinite population of individuals indexed by e_i, one's ability to earn a secular income, and z_i, one's ideal level of doctrinal strictness.

  - $e_i \sim g(e|\theta)$, where θ captures human development and $g(e|\theta)$ satisfies the monotone likelihood ratio property (MLRP).

  - $z_i \sim h(z|\rho)$, where ρ captures society's overall preference for doctrinal strictness and $h(z|\rho)$ satisfies the MLRP.

- **Actions:** Actions are taken simultaneously by all actors in the two-period game.

  - Period 1: Choose denomination $y_i \in Y$.

  - Period 2: Choose religious participation: $r_i \in [0,1]$ (constraint to $[0,1]$ only needed for social benefits case).

- **Expected Utility:** $EU_i = \int [u_i^a(v_i(w_i,\theta), r_i, \phi)] f(w_i|e_i) dw_i - u_i^b(r_i^y(y_i) - r_i) - u_i^c(|y_i - z_i|)$.

  - Income $w_i \sim f(w_i|e_i)$

  - Net income $v_i(w_i, \theta)$ is weakly increasing in both parameters.

  - Government regulation: ϕ. More positive values correspond to more repression of religion, more negative values to more repression of secular activity.

  - $u^a(v(w_i, \theta), r_i, \phi)$ details tradeoffs in material and psychic benefits from religious and secular sources. We assume: $\frac{\partial u_i^a}{\partial v_i} \geq 0$, $\frac{\partial^2 u_i^a}{\partial v_i^2} \leq 0$, $\frac{\partial^2 u_i^a}{\partial r_i \partial v_i} \leq 0$, $\frac{\partial^2 u_i^a}{\partial r_i \partial \phi} \leq 0$.

- $u_i^b(r_i^y(y_i) - r_i)$ details tradeoffs between one's desired level of religious participation and that expected by one's chosen denomination. Let $r_i^d = r_i^y(y_i) - r_i$. When $r_i^d \geq 0$, $u^b > 0$, $\frac{\partial u_i^b}{\partial r_i^d} \geq 0$, $\frac{\partial^2 u_i^b}{\partial (r_i^d)^2} \geq 0$. When $r_i^d < 0$ we have two cases:

  (a) conformity: $u^b > 0$, $\frac{\partial u_i^b}{\partial r_i^d} \leq 0$, $\frac{\partial^2 u_i^b}{\partial (r_i^d)^2} \geq 0$.

  (b) social benefits: $u^b < 0$, $\frac{\partial u_i^b}{\partial r_i^d} \geq 0$, $\frac{\partial^2 u_i^b}{\partial (r_i^d)^2} \geq 0$.

- $u_i^c(|y_i - z_i|)$ captures the cost of one's chosen denomination deviating from one's ideal level of doctrinal strictness. Let $y_i^d = |y_i - z_i|$. Then we assume: $\frac{\partial u_i^c}{\partial y_i^d} \geq 0$, $\frac{\partial^2 u_i^c}{\partial (y_i^d)^2} \geq 0$.

- **Equilibrium Concept:** Subgame perfection, abetted by monotone comparative statics. With an infinite population and fixed denominations, no individual's actions affect any other individual's actions, so each individual decides independently. The "equilibrium" of the model consists of the pair $r_i^*(e_i, z_i, \theta, \rho, \phi)$, $y_i^*(e_i, z_i, \theta, \rho, \phi)$ that maximizes expected utility subject to the constraint that $y_i^* \in Y$. Equilibrium existence follows from decreasing returns to, and increasing costs of, religious participation for all individuals in all but the social benefits case, constraint of participation to $[0, 1]$ in that case, and continuity in the utility functions.

Our model comprises individuals in an infinite (very large is sufficient) population who derive utility from both the secular and religious worlds. An individual's *secular* utility is dependent on one primary input, her net income, v_i, which comprises wages, taxes, and social services related to the secular world. Because wages, taxes, and social services depend on the incomes of others, we let v_i be a function of both individual (w_i) and population ($\sum_{k \neq i} w_k$) income. As income is in general stochastic, depending on things like prior income, education, and health, we assume that one's income is a random variable, given by the probability distribution function $f(w_i | e_i)$. This pdf is conditional on e_i, a parameter representing all factors that influence income, including, but not limited to, education, literacy, health, and prior history. We assume that this pdf satisfies the monotone likelihood ratio property (MLRP), implying that worse incomes do not become relatively more likely as e_i rises (Ashworth & de Mesquita 2006).[1] The ability to earn a secular income varies across the population in a manner dependent on the level of human development. As

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[1] The monotone likelihood ratio property implies that the pdf also satisfies a first-order stochastic dominance (FOSD) relation. Formally, for the distribution of w, MLRP amounts to the condition that $\frac{f(w|e_1)}{f(w|e_2)}$ is not decreasing in w if $e_1 \geq e_2$. The MLRP implies that $f(w|e_1)$ first-order stochastically dominates $f(w|e_2)$ if $e_1 \geq e_2$.

a result, we let the distribution of e across the population be given by the probability distribution function $g(e|\theta)$, where θ is a parameter indicating the overall level of development. As before, we assume that this pdf satisfies the MLRP, implying that a lower ability to earn a secular income does not become relatively more likely as societies develop. This means that the population income is increasing in θ, allowing us to write $v_i(w_i, \theta)$. We assume that one's net income is increasing in both individual income (wages) and development. This means that, holding one's own income constant, taxes do not increase faster than services increase as society grows richer, and there are no perverse incentives to general prosperity.

An individual's *religious* utility is dependent on four primary inputs. The first input, which we refer to as religious participation, comprises the time, effort, and money that an individual devotes to the practice of religion, r_i. Religious goods and benefits are increasing in participation. The second input is the level of exogenous pressure exerted by the state, ϕ, on religious participation. Positive values of ϕ correspond to state repression and regulation of religion, whereas negative values correspond to 'blue laws' or other state regulations designed to enforce religious standards and limit secular activities. The third input is the doctrinal strictness, y_i, of the religious denomination with which individual i chooses to associate. The fourth input is the ideal level of doctrinal strictness, z_i, that individual i would like in a religious denomination if denominations representing all strictness levels were available and if there were no other benefits to be obtained from acting religiously (Stark & Finke 2000, Montgomery 2003).

Some countries in the world exhibit higher levels of comfort with doctrinal strictness than others, perhaps because of the way that individuals are socialized as children or because religions differ in the extent to which they emphasize strictness. As a result, we let the distribution of z across the population be given by the pdf $h(z|\rho)$, where ρ is a population parameter indicating a country's overall preference for doctrinal strictness. We assume that this pdf satisfies the MLRP, implying that a lower ideal level of doctrinal strictness does not become relatively more likely as a country increases its overall preference for doctrinal strictness. For simplicity, and to avoid biasing our results by assuming *ex ante* that those enjoying high net income are those least likely to prefer more doctrinal strictness, we assume that the distributions of e and z are independent. That is to say, we assume that there is no correlation between parameters e_i and z_i.[2]

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[2] Our results generalize to the case where e_i and z_i are negatively correlated. Such a case might arise, perhaps, because a greater focus on secular education in childhood is associated with less development of comfort with doctrinal strictures. They do not generalize, however, to the reverse case. We discuss this formally at the end of our proof of Proposition 2 in the next subsection.

Putting these secular and religious inputs together, we obtain an individual's expected utility function:

$$EU_i = \int [u_i^a(v_i(w_i, \theta), r_i, \phi)] f(w_i|e_i) dw_i - u_i^b(r_i^y(y_i) - r_i) - u_i^c(|y_i - z_i|). \tag{1}$$

The first term, u^a, captures a rational tradeoff between the material and psychic goods that can be obtained via religious participation, and the degree to which lost time, money, and effort devoted to religious participation detract from leisure time and the pursuit and enjoyment of secular goods. The first element of u^a is one's net income, the second is one's level of religious participation, and the third is a function capturing the level of government regulation. This last element conditions the tradeoff, as it helps to determine the relative costs and benefits of religious and secular activity. The second term, u^b, captures social pressure to conform to a denomination's strictures, and is a function of the difference between the level of participation expected given the chosen strictness y_i, $r_i^y(y_i)$, and one's actual level of participation, r_i. In line with the real world, we assume that $r_i^y(y_i)$ is increasing in y_i, so that more strict denominations have higher expectations for participation. The third term, u^c, captures the cost of deviating from one's ideal level of doctrinal strictness, and is thus a function of the magnitude of this deviation. For convenience, we assume that each component of Eq. (1) is thrice continuously differentiable, though this is not necessary for our results.

We now specify how the utility terms, u^a, u^b, and u^c depend on their parameters, starting with u^a. We assume that u^a is increasing in one's net income, but that one experiences decreasing returns, i.e., $\frac{\partial u_i^a}{\partial v_i} \geq 0$ and $\frac{\partial^2 u_i^a}{\partial v_i^2} \leq 0$. Not all individuals in the real world will benefit from religious participation. As a result, we make no assumptions about the dependence of u^a on r_i – some individuals may benefit, while others may not. Following the literature, we assume that religious participation is a substitute for net income (and so individual income), so that $\frac{\partial^2 u_i^a}{\partial r_i \partial v_i} \leq 0$ (Iannaccone 1992, McBride 2008, McBride 2010). In other words, individuals experience decreasing marginal utility to income the higher is their religious participation, and vice versa. The logic behind this is straightforward: higher levels of participation entail less time to produce additional income and to enjoy goods procured via income, as well as more net earnings given to the denomination, again leading to less procurement of secular goods. Along similar lines, we assume that religious participation, r_i, and government regulation, ϕ, also act as substitutes in u^a: higher positive values of ϕ make participation increasingly costly, while negative values increase the cost to secular activities, decreasing the relative cost to religious participation.

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We now turn to u^b. Let $r^d = r_i^y(y_i) - r_i$ be the difference between social expectations for religious participation and one's actual level of participation, and note that the sign of the difference is allowed to matter. Since an individual is likely to be increasingly penalized the more she falls below social expectations for participation, we assume that u^b is increasing in r^d at an increasing rate when $r_i \leq r_i^y(y_i)$. The appropriate assumption when $r_i > r_i^y(y_i)$ is not so obvious and, as a result, we consider two cases. In the *conformity* case, going beyond expectations is also frowned upon, and u^b is increasing in $-r^d$ at an increasing rate. In the *social benefits* case, $u^b < 0$ for $r_i > r_i^y(y_i)$, so that the cost term inverts to become a positive social benefit in this range. Here providing more religious participation than expected is viewed favorably, so that $-u^b$ is increasing in $-r^d$, the degree to which participation exceeds expectations, but at a decreasing rate.

With respect to u^c, we assume that it is is increasing in the extent to which the doctrinal strictness of one's chosen denomination deviates from one's ideal level of strictness, i.e., $|y_i - z_i|$, and that the marginal increase in u^c is increasing as well. That is, both the cost and the marginal increase in cost to choose a denomination that deviates from one's most comfortable level of strictness is increasing in the size of the deviation.

There are three parameters in our model associated with individual religious behavior, two of which are endogenous and driven by individual choices. In our two-period model, individuals first choose a level of doctrinal strictness by affiliating with one of the available denominations in the religious marketplace, y_i. They then choose a level of religious participation, r_i, conditional on affiliation. Each individual makes her choices so as to maximize her expected utility, given in Eq. (1). We assume that the set of available denominations with which to affiliate is Y, with each denomination in this set denoted by y^j. The denomination with the minimum doctrinal strictness is taken to be 0. Given our focus on demand-side explanations for religious participation, we take the set of available denominations with which to affiliate, Y, as exogenous. We should note, however, that it is relatively straightforward to include an entry and location game before our model's first period, in which religious denominations first choose whether to enter the religious market by paying a cost and then choose to adopt a particular level of doctrinal strictness (McBride 2010, Gaskins, Golder & Siegel 2013). Our inferences are robust to making endogenous the set of available denominations with which individuals can affiliate, under reasonable conditions on utilities, via this model extension.

The parameter that is not determined endogenously for each individual is one's ideal level of doctrinal strictness, z_i. Unlike one's level of religious participation, r_i, and denominational affiliation, y_i, which are affected by social pressure, potential loss of secular benefits, and the availability of concordant denominations, z_i represents a fundamental preference for adherence to religious and social convention. Such adherence is typically associated with social conservatism, and we adopt this interpretation here. That is, we associate the parameter z_i with the degree to which one is socially conservative, with higher values corresponding to a more conservative person. This is entirely consistent with supply-side models of religion, which assume that individuals can be ranked along a continuum according to the intensity of their religious preferences, with more intense religious preferences indicating a greater "tension" with the secular world (Iannaccone 1994, Barros & Garoupa 2002, Montgomery 2003, McBride 2008, McBride 2010). Indeed, it is common for supply-side models to explicitly refer to individuals with preferences that are in tension with the secular world (high z_i) as socially conservative or ultra-strict (Stark & Finke 2000, 197).

The "equilibrium" of our model consists of a level of religious participation, $r_i^*(e_i, z_i, \theta, \rho, \phi)$ and a level of doctrinal strictness, $y_i^*(e_i, z_i, \theta, \rho, \phi)$, that maximize Eq. (1) subject to the constraint that $y_i^* \in Y$ and the constraint that y_i is chosen first. We find this using backward induction (with an assist from monotone comparative statics). That such an equilibrium exists follows immediately from the assumptions of decreasing returns to, and increasing costs of, religious participation for all individuals in all but the social benefits case, and continuity in the utility functions. For the social benefits case, we additionally assume that $r_i \in [0, 1]$, which affects none of our results.

Propositions and Proofs

We now examine the comparative statics of the model, i.e., the effect of the model parameters, $e_i, z_i, \theta, \rho, \phi$, on religious participation and denomination choice, as well as on attitudes towards social conservatism. In what follows, we make frequent use of the theory of monotone comparative statics. For convenience, we refer to all theorems that we utilize by their numbers in Ashworth and Bueno de Mesquita (2006). Citations to the original theorems may be found therein. As noted above, all of our distributions satisfy the monotone likelihood ratio property (MLRP), which implies that they also satisfy a related first-order stochastic dominance (FOSD) relation. Formally, for the distribution of w, MLRP amounts to the condition

that $\frac{f(w|e_1)}{f(w|e_2)}$ is not decreasing in w if $e_1 \geq e_2$, and similarly for $g(e|\theta)$ and $h(z|\rho)$. The MLRP implies that $f(w|e_1)$ first-order stochastically dominates $f(w|e_2)$ if $e_1 \geq e_2$, and again likewise for the other two distributions.

We begin with an interim result that helps us understand later comparative statics. The following lemma states that the more strict is the denomination chosen by an individual, the more that individual will engage in religious participation.

Lemma 1 (Strictness): *An individual's optimal level of religious participation, $r_i(y_i)$, (weakly) increases with the strictness of her chosen denomination, y_i.*

Proof of Lemma 1:

The first step in backward induction gives us the optimal response $r_i^*(y_i; e_i, z_i, \theta, \rho, \phi)$ that maximizes Eq. (1) in the text for a given value of y_i. Only u^b depends on both y_i and r_i, so the direct dependence of $r_i^*(y_i)$ on y_i must arise from this term. If $r_i \leq r_i^y(y_i)$, then, by assumption, u^b is increasing in $r^d = r_i^y(y_i) - r_i$, and at an increasing rate, which implies $\frac{\partial^2 u^b}{\partial (r^d)^2} = \frac{\partial^2 u^b}{\partial (r_i^y)^2} \geq 0$. Since $\frac{\partial r_i^y}{\partial y_i} \geq 0$, this has the same sign as $\frac{\partial^2 u^b}{\partial (y_i)^2}$, which has the same sign as $-\frac{\partial^2 u^b}{\partial y_i \partial r_i}$. Thus $\frac{\partial^2 u^b}{\partial y_i \partial r_i} \leq 0$, and u^b is submodular in r_i and y_i. This implies that individual i's expected utility, EU_i, is supermodular in r_i and y_i for $r_i \leq r_i^y(y_i)$.

Now consider $r_i > r_i^y(y_i)$. There are two cases here. In the first, the case of conformity, the exact same logic applies, switching the order of differentiation: u^b is convex in r^d, and so convex in r_i, and so the cross-partial with r_i and y_i is negative. In the second, the case of social benefits, u^b is negative and increasing in r^d, but at a declining rate. So $\frac{\partial^2 u^b}{\partial (r^d)^2} = \frac{\partial^2 u^b}{\partial (r_i^y)^2} \geq 0$. This has the same sign as $-\frac{\partial^2 u^b}{\partial y_i \partial r_i}$, and again the same logic holds. Thus, in all cases and for all relative values of r_i and $r_i^y(y_i)$, EU_i is supermodular in r_i and y_i. By Theorem 1 in Ashworth and Bueno de Mesquita (2006, 218), this implies that $r_i^*(y_i)$ is weakly increasing in y_i, giving us Lemma 1. Since u^b depends on no other terms than y_i and r_i, and as Lemma 1 provides the relevant dependence of the second on the first, we need no longer consider the conformity and social benefits cases separately in the proofs that follow.

Lemma 1 provides the tie between religious participation and denominational strictness: when the latter increases, it puts pressure on the former to do the same. The proof of the lemma also implies that any parameter change that induces one to increase one's equilibrium level of participation for a given level

of y also leads one to (weakly) increase y, unless there is also a direct, opposite effect of that parameter on the choice of y. Since y interacts only with r and z in Eq. (1), the only parameter that may have such a direct effect is z. As we show in the proof of Proposition 1, the direct effect of z on y is positive; that is, y^* is increasing in z. This insight implies that Proposition 1 holds for both religious participation *and* denominational strictness.

Proposition 1 (Individual Religious Participation)

An individual's optimal level of religious participation, r_i^*:

  (a) *(weakly) decreases as her ability to produce secular income, e_i, increases.*
  (b) *(weakly) increases as her ideal level of doctrinal strictness, z_i, increases.*
  (c) *(weakly) decreases with human development, θ.*
  (d) *(weakly) decreases as government regulations, ϕ, designed to suppress religious practice increase, and (weakly) increases as government regulations, ϕ, designed to suppress secular practice increase.*

Proof of Proposition 1:

First, note that only u^a contains e, and that it does not contain y. Thus, y cannot directly affect the marginal effect of e on the individual choice of r_i. This implies that to prove Proposition 1a we need only discern the relationship between $r_i^*(y_i)$ and e. This relationship will hold for any choice of y_i. To obtain the proposition, recall that, by assumption, u^a is supermodular in w and $-r$. Because $f(w|e)$ satisfies the monotone likelihood ratio property (MLRP), we have that $-r^*$ is non-decreasing in e or, more clearly, that r^* is weakly decreasing in e by Theorem 5 in Ashworth and Bueno de Mesquita (2006, 228). Thus, treating e as an individual's potential to produce income, we see that participation is (weakly) decreasing in the degree to which an individual expects to produce income. This gives us Proposition 1a. Because EU_i is supermodular in y_i and r_i by the proof of Lemma 1, then $y_i^*(e_i, z_i, \theta, \rho, \phi)$ must be weakly decreasing in e as well.

To prove Proposition 1b, first assume that the set Y contains all possible denominations, implying that all individuals may choose their optimum y_i. By Lemma 1, $r_i^*(y_i)$ is weakly increasing in y_i. The only other parameter with which y_i directly interacts is z_i, in the function u^c. By an identical argument to the conformity case in the proof of Lemma 1, EU_i is supermodular in y_i and z_i. Since r_i and z_i do not interact directly in EU_i, this implies that y_i^* is weakly increasing in z_i. As $r_i^*(y_i)$ is weakly increasing in y_i and does not depend directly on z_i, it must therefore also be weakly increasing in z_i. Now assume that the set

Y does not contain all possible denominations. This implies that a more beneficial denomination might not be available to an individual with increased z_i; however, it does not change the result that no individual with an increased z_i would want to choose a denomination with a lower value of y. Thus the result continues to hold for any fixed Y. This gives us Proposition 1b.

Propositions 1c and 1d are straightforward, using the same logic as in 1a and 1b. For 1c, note that v_i is increasing in θ and that v_i and r_i are substitutes in u^a, implying that θ and r_i are substitutes in u^a as well. This yields Proposition 1c. For 1d, note that ϕ and r_i are substitutes in u^a, so that u^a is supermodular in ϕ and $-r$. This immediately yields the proposition.

Individually optimal levels of religious participation and denominational strictness depend on the exogenous parameters θ and ϕ, plus two parameters for which we have assumed distributions across the population: e and z. We can use these distributions – $g(e|\theta)$ and $h(z|\rho)$ – to extend several results to the aggregate level.

Proposition 2 (Aggregate Religious Participation)

The aggregate level of religious participation in a population:

  (a) *(weakly) decreases with human development, θ.*
  (b) *(weakly) increases with the population's preference for doctrinal strictness, ρ.*
  (c) *(weakly) decreases as government regulations, ϕ, designed to suppress religious practice increase, and (weakly) increases as government regulations, ϕ, designed to suppress secular practice increase.*

Proof of Proposition 2:

For convenience we assume a common utility function, other than differences in parameters, though this is not strictly necessary. Define the average (aggregate) level of participation in the population to be $R_{\text{avg}}(\theta, \rho, \phi) = \int h(z|\rho)dz \int r^*(e, z; \theta, \rho, \phi)g(e|\theta)de$. Consider the integral over e first. By the definition of first order stochastic dominance (FOSD), the fact that $-r^*$ is non-decreasing in e means that $\int -r^*(e, z; \theta', \rho, \phi)g(e|\theta_1)de \geq \int -r^*(e, z; \theta', \rho, \phi)g(e|\theta_2)de$ for all $\theta_1 \geq \theta_2$, at every value of z, for all θ'. Since, from Proposition 1c, r^* is weakly decreasing in θ, we have that $\int r^*(e, z; \theta_1, \rho, \phi)g(e|\theta_1)de \leq \int r^*(e, z; \theta_2, \rho, \phi)g(e|\theta_2)de$ for these cases. Since this is true for all z, it is true for the integral over z. Thus, we have that aggregate average participation is weakly decreasing in the overall level of human development of the population. This gives us Proposition 2a.

Now switch the order of integration, performing the integral over z first. By the definition of FOSD, the fact that r^* is weakly increasing in z means that $\int r^*(e, z; \theta, \rho, \phi) h(z|\rho_1) dz \geq \int r^*(e, z; \theta, \rho, \phi) h(z|\rho_2) dz$ for all $\rho_1 \geq \rho_2$, at every value of e. Since this is true for all e, it is true for the integral over e. Thus, we have that aggregate average participation is weakly increasing in the overall level of preference for doctrinal strictness in the population. This gives us Proposition 2b.

Finally, Proposition 2c is far simpler, and follows directly from Proposition 1d, as neither conditional distribution depends at all on ϕ.

Rather than assume that e and z are independently distributed as we have done here, one might reasonably suspect that they are negatively correlated. In other words, one might believe that those people with a high intrinsic interest in religious strictness would be less likely to have high incomes because socialization focused on religious strictness early in life might not accompany a similar devotion to secular education. Our results still go through in this case. Let $g(e, z|\theta, \rho)$ be the joint distribution, so that the marginal distribution for e is $g(e|z, \theta, \rho) = \frac{g(e,z|\theta,\rho)}{g(z|\theta,\rho)}$ with $g(z|\theta, \rho) = \int g(e, z|\theta, \rho) de$. Assume that the two parameters e and z are negatively correlated in the sense that $g(e|z_2, \theta, \rho)$ first order stochastically dominates $g(e|z_1, \theta, \rho)$ for all $z_1 \geq z_2$. Replacing $g(e|\theta_i)$ with $g(e|z, \theta_i, \rho)$ in our analysis does not alter the first step of the proof for 2a above. In other words, the integral of $r^*(e, z; \theta', \rho, \phi)$ over e is still weakly decreasing in θ for all levels of z in the cases given. Further, as $g(e, z|\theta_i, \rho)$ places smaller weights on higher values of z the larger e is, increasing θ effectively shifts the marginal distribution of z lower. As $r^*(e, z; \theta', \rho, \phi)$ is increasing in z, this shift further decreases average participation. Thus, the increase in θ leads to decreases in both integrals under negative correlation rather than just the inner one, and so Proposition 2a holds for negatively correlated parameters as well as the case where e and z are assumed to be distributed independently. This same argument also holds for Proposition 2b. Note that our argument would not hold if we were to assume that people who have a high intrinsic interest in religion and, therefore, devote more time to religious activity are also more likely to have high incomes. However, we believe that this assumption of positive correlation is less reasonable.

Proposition 3 (Social Conservatism)

For any fixed definition of "religious":

  (a) *the population of religious individuals will be (weakly) more socially conservative than the population*

average.

(b) *the average level of social conservatism of religious individuals in a country will be (weakly) increasing with human development.*

Proof of Proposition 3:

Since $r^*(e, z, \theta, \rho, \phi)$ is (weakly) increasing in z, there must exist a cutoff $z'(r', e, \theta, \rho, \phi)$ such that all individuals possessing $z_i \geq z'$ choose optimal levels of religious participation $r_i^* \geq r'$, and all individuals possessing $z_i < z'$ choose optimal levels of religious participation $r_i^* \leq r'$. This implies that the mean level of z for those individuals below the cutoff is weakly less than the mean level of z for those above the cutoff. This completes the proof of Proposition 3a.

As $r^*(e, z, \theta, \rho, \phi)$ is (weakly) decreasing in e for all z, it must be the case that $z'(r', e_1, \theta, \rho, \phi) \geq z'(r', e_2, \theta, \rho, \phi)$ for all $e_1 \geq e_2$. Thus, $z'(r', e, \theta, \rho, \phi)$ is weakly increasing in e. Similarly, as $r^*(e, z, \theta, \rho, \phi)$ is (weakly) decreasing in θ for all z, it must be the case that $z'(r', e, \theta, \rho, \phi)$ is weakly increasing in θ. Using the same logic of FOSD as in the proof of Proposition 2, this implies that the average $Z'(r', \theta, \rho, \phi) = \int z'(r', e, \theta, \rho, \phi) g(e|\theta) de$ is increasing in θ. So, assuming the distribution of z in the population remains constant, as θ increases: 1) the mean level of doctrinal preference of those individuals with $r_i^* \geq r'$ is weakly increasing; and 2) the standard deviation of doctrinal preference of those individuals with $r_i^* \geq r'$ is weakly decreasing. Since r' is arbitrary, it must be true that increasing the level of human development in the population leads (weakly) to religious subpopulations (i.e. those whose members surpass some level of religious participation) with greater average comfort with doctrinal strictness and greater uniformity of belief. Associating doctrinal preference with social conservatism completes the proof of Proposition 3b.

Online Appendix B: Data and Key Variables

In what follows, we provide more detail on several of our key variables: *Religious Attendance*, *Left-Right Ideology*, *Divorce*, *Euthanasia*, *Abortion*, *Suicide*, *Homosexuality*, *Government Regulation*, *Social Regulation*, *Human Development Index*, and *GDP per capita*.

The first seven variables come from the four-wave integrated data file for the World Values Survey-European Values Survey that covers the years 1981-2004. The data (version 20060423) were downloaded from `http://www.wvsevsdb.com/wvs/WVSData.jsp` on May 28, 2009. Technical information about how the surveys were implemented in each country can be found at `http://www.wvsevsdb.com/wvs/WVSTechnical.jsp`.[3]

1. *Religious Attendance* is based on the following question (f028) in the WVS codebook:

> "Apart from weddings, funerals, and christenings, about how often do you attend religious services these days? More than once per week, once a week, once a month, only on special holy days, once a year, less often, or practically never?"

We reversed the original WVS scale for this variable so that higher values indicate higher levels of religious participation. Ultimately, *Religious Attendance* is measured on a 1-8 scale, with 1 meaning that respondents practically never attend religious services and 8 meaning that they attend more than once a week. In terms of summary statistics, $N = 249,063$, $\mu = 4.34$, $\sigma = 2.56$.

2. *Left-Right Ideology* is based on the following question (e033) in the WVS codebook:

> "In political matters, people talk of "the left" and "the right." How would you place your views on this scale, generally speaking?"

Left-Right Ideology is coded on a 1-10 scale, where 1 means 'left' and 10 means 'right.' In terms of summary statistics, $N = 190,669$, $\mu = 5.53$, $\sigma = 2.26$.

3. *Homosexuality* is based on the following question (f118) in the WVS codebook:

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[3]Although there have been some concerns about the sampling procedure used by the World Values Survey in some countries, Inglehart and Welzel (Inglehart & Welzel 2010) demonstrate that, where questions are similar, the WVS provides similar results to other surveys such as the International Social Survey Programme, the European Values Survey, the European Social Survey, Gallup World Poll, Afrobarometer, and other regional barometers.

"Please tell me for each of the following statements whether you think it can always be justified, never be justified, or something in between. 1 means 'Never justifiable' and 10 means 'Always justifiable.' Homosexuality."

We reversed the original WVS scale for this variable so that higher values indicate greater social conservatism with respect to homosexuality. Ultimately, *Homosexuality* is coded on a 1-10 scale, where 1 indicates that homosexuality is always justifiable and 10 indicates that homosexuality is never justifiable. In terms of summary statistics, $N = 238, 282$, $\mu = 8.03$, $\sigma = 2.88$.

4. *Abortion* is based on the following question (f120) in the WVS codebook:

"Please tell me for each of the following statements whether you think it can always be justified, never be justified, or something in between. 1 means 'Never justifiable' and 10 means 'Always justifiable.' Abortion."

We reversed the original WVS scale for this variable so that higher values indicate greater social conservatism with respect to abortion. Ultimately, *Abortion* is coded on a 1-10 scale, where 1 indicates that abortion is always justifiable and 10 indicates that abortion is never justifiable. In terms of summary statistics, $N = 246, 859$, $\mu = 7.44$, $\sigma = 2.77$.

5. *Divorce* is based on the following question (f121) in the WVS codebook:

"Please tell me for each of the following statements whether you think it can always be justified, never be justified, or something in between. 1 means 'Never justifiable' and 10 means 'Always justifiable.' Divorce."

We reversed the original WVS scale for this variable so that higher values indicate greater social conservatism with respect to divorce. Ultimately, *Divorce* is coded on a 1-10 scale, where 1 indicates that divorce is always justifiable and 10 indicates that divorce is never justifiable. In terms of summary statistics, $N = 247, 376$, $\mu = 6.52$, $\sigma = 2.90$.

6. *Euthanasia* is based on the following question (f122) in the WVS codebook:

"Please tell me for each of the following statements whether you think it can always be justified, never be justified, or something in between. 1 means 'Never justifiable' and 10 means 'Always justifiable.' Euthanasia."

We reversed the original WVS scale for this variable so that higher values indicate greater social conservatism with respect to euthanasia. Ultimately, *Euthanasia* is coded on a 1-10 scale, where 1 indicates that euthanasia is always justifiable and 10 indicates that euthanasia is never justifiable. In terms of summary statistics, $N = 228,797$, $\mu = 7.34$, $\sigma = 3.08$.

7. *Suicide* is based on the following question (f123) in the WVS codebook:

> "Please tell me for each of the following statements whether you think it can always be justified, never be justified, or something in between. 1 means 'Never justifiable' and 10 means 'Always justifiable.' Suicide."

We reversed the original WVS scale for this variable so that higher values indicate greater social conservatism with respect to suicide. Ultimately, *Suicide* is coded on a 1-10 scale, where 1 indicates that suicide is always justifiable and 10 indicates that suicide is never justifiable. In terms of summary statistics, $N = 238,763$, $\mu = 8.78$, $\sigma = 2.16$.

The next two variables come from the aggregated International Religious Freedom (IRF) Data (Grim & Finke 2006), which can be found in the Association of Religion Data Archive. The data were downloaded from `http://www.thearda.com/Archive/Files/Descriptions/IRFAGG.asp` on June 2, 2009. Every year since 1999, U.S. embassies produce an International Religious Freedom Report on their host country. Together these reports cover 196 countries. The IRF data codes these reports using a 243-item coding instrument (questionnaire). As Grim and Finke (2006, 9) note, "reporting adheres to a common set of guidelines, and training is given to embassy staff, who investigate the situation and prepare reports ... Once an embassy completes a report, this report is vetted by various State Department offices that have expertise in the affairs of that country and in human rights." The coding of all 196 countries was done by the lead rater. Two other raters coded 142 of the 196 countries. The inter-coder reliability was high, with a Cronbach's alpha of 0.9047 (Grim & Finke 2006, 12). We use two variables from the IRF dataset: *Government Regulation* and *Social Regulation*.

8. *Government Regulation* is defined as the restrictions placed on the practice, profession, or selection of religion by the official laws, policies, or administrative actions of the state. *Government Regulation* is a

summary measure coded on a 0-10 scale based on six underlying questions:

(a) Does the report mention whether foreign missionaries are allowed to operate. 0 = allowed and/or no limits reported, 1 = allowed, but within restrictive limits, and 2 = prohibited.

(b) Does the report mention that proselytizing, public preaching, or conversion is limited or restricted. 0 = no, 1 = yes, but (equally) for all religions, 2 = yes, but only for some religions.

(c) Does the report indicate that the government interferes with an individual's right to worship? 0 = no, or no interference, 1 = some interference, 2 = severe interference.

(d) How is freedom of religion described in the report? 0 = law/constitution provides for freedom of religion and the government 'generally respects' this right in practice, 1 = law/constitution provides for freedom of religion and the government generally respects this right in practice, but some problems exist, e.g., in certain locations, 2 = limited and/or rights are not protected, 3 = does not exist.

(e) Does the report mention that the government 'generally respects' this right in practice? 0 = yes, 1 = yes, but exceptions or restrictions are mentioned, 2 = the phrase 'generally respects' is not used.

(f) Does the report specifically mention that the government policy contributes to the generally free practice of religion. 0 = yes, 1 = yes, but exceptions are mentioned, 2 = no.

To construct *Government Regulation*, each of the six underlying variables was re-scaled to a 0 to 1 range, and then multiplied by 1.6667 to give an additive maximum of 10 (Grim & Finke 2006, 13). In terms of summary statistics, $N = 264,370$, $\mu = 3.87$, $\sigma = 2.85$.

9. *Social Regulation* is defined as the restrictions placed on the practice, profession, or selection of religion by other religious groups, associations, or the culture at large. This form of regulation might be tolerated or even encouraged by the state but is not formally endorsed or implemented by government action. *Social Regulation* is a summary measure coded on a 0-10 scale based on five underlying questions:

(a) Social attitudes towards other or nontraditional religions are reported to be 0 - amicable, 1 = discriminatory (but not negative), 2a = negative just in certain areas, 2b = negative just wards certain religious branches, 3 = both 2a and 2b, 4 = hostile.

(b) According to the report, what are social attitudes to conversions to other religions? 0 = no problems reported, 1 = some tension, 2 = negative, 3 = physically hostile.

(c) Does the report mention that traditional attitudes and/or edicts of the clerical establishment strongly discourage proselytizing? 0 = no, 1 = yes.

(d) According to the report, do established or existing religions try to shut out new religions in any way? 0 = no, 1 = yes.

(e) What is the situation regarding social movements in relation to religious brands in the country? 0 = none or amicable, 1 = flashes of activity, 2 = regional and organized activity, 3 = national and organized activity.

To construct *Social Regulation*, each of the five underlying variables was re-scaled to a 0 to 1 range, and then multiplied by 2 to give an additive maximum of 10 (Grim & Finke 2006, 19). In terms of summary statistics, $N = 264,370$, $\mu = 4.05$, $\sigma = 3.08$.

10. *Human Development Index (HDI)* is based on the 2007/2008 HDI index trends for 1975, 1980, 1985, 1990, 1995, 2000, and 2005 from the United Nations Development Programme (`http://hdr.undp.org/en/media/HDR_20072008_Table_2.pdf`). Where necessary, we employ linear interpolations to calculate *HDI* for the intervening years.[4] *HDI* has a 0-1 scale, and is a composite measure of a country's level of human development based on three underlying dimensions:

(a) Life Expectancy Index (health): The life expectancy index measures the relative achievement of a country in life expectancy at birth. It is calculated as

$$\text{Life Expectancy Index} = \frac{\text{Average Age at Death} - \text{Minimum Value}}{\text{Maximum Value} - \text{Minimum Value}},$$

where the minimum and maximum values were taken as 25 years and 85 years, respectively.

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[4]In previous work, Norris and Inglehart (2004) also use HDI as their measure of societal development. Instead of using the HDI index trends, though, they use HDI scores from various annual Human Development Reports. This is problematic because these annual scores are not comparable across time due to data revisions and changes in methodology (UNDP 2007, 222).

(b) Education Index (education): The education index measures a country's relative achievement in both adult literacy and combined primary, secondary, and tertiary gross enrollment. First, an index of adult literacy and one for combined gross enrollment are calculated. Then these two indices are combined to create the education index, with two-thirds weight given to adult literacy and one-third weight to combined gross enrollment. The adult literacy index is calculated as:

$$\text{Adult Literacy Index} = \frac{\text{Adult Literacy Rate} - \text{Minimum Value}}{\text{Maximum Value} - \text{Minimum Value}},$$

where the minimum and maximum values were taken as 0% and 100%, respectively. The gross enrollment index is calculated as:

$$\text{Gross Enrollment Index} = \frac{\text{Combined Gross Enrollment Rate} - \text{Minimum Value}}{\text{Maximum Value} - \text{Minimum Value}},$$

where the minimum and maximum values were taken as 0% and 100%, respectively. Finally, the Education Index is calculated as:

$$\text{Education Index} = \frac{2}{3}\text{Adult Literacy Index} + \frac{1}{3}\text{Gross Enrolment Index}.$$

(c) GDP Index (standard of living): The GDP index is calculated using adjusted GDP per capita (PPP US$). It is calculated as:

$$\text{GDP Index} = \frac{\log(\text{Actual GDP}) - \log(\text{Minimum Value})}{\log(\text{Maximum Value}) - \log(\text{Minimum Value})},$$

where the minimum and maximum values were taken as $0 and $40,000.

Finally, the Human Development Index is calculated as:

$$\text{Human Development Index} = \frac{1}{3}\text{Life Expectancy Index} + \frac{1}{3}\text{Education Index} + \frac{1}{3}\text{GDP Index}.$$

More technical information about exactly how HDI is calculated can be found at `http://hdr.undp.org/en/media/HDR_2011_EN_TechNotes.pdf`. In terms of summary statistics, $N = 257, 485$,

$\mu = 0.80$, $\sigma = 0.12$.

11. *GDP per capita* measures real GDP per capita in thousands of 1996 purchasing power parity (PPP) international dollars. The data come from the Penn World Tables 6.1 and can be found at `http://datacentre2.chass.utoronto.ca/pwt61/`. For more technical information about PWT 6.1, see `http://datacentre2.chass.utoronto.ca/pwt61/docs/Doc-tech.pdf`. In terms of summary statistics, $N = 215,276$, $\mu = 12.57$, $\sigma = 7.81$.

Online Appendix C: Concepts and Measures

In what follows, we illustrate the connection between our theoretical and empirical variables. We also indicate the predicted sign of the coefficient on each of the independent variables. We start with our analysis of religious participation, and then turn to our analysis of social conservatism.

Religious Participation

Table 1: Theoretical and Empirical Variables in our Analysis of Religious Attendance

Dependent Variable: *Religious Attendance*, r_i		
Theoretical Variable	Empirical Variable	Predicted Sign
Individual-Level Variables		
Ability to earn secular income, e_i	*Income*	Negative
	Male	Negative
	Older than 65	Positive
	Education	Negative
Aggregate-Level Variables		
Human development, θ	*Human Development Index*	Negative
	GDP per capita	Negative
Government regulation, ϕ	*Government Regulation*	Negative
	Social Regulation	Negative
	Communist	Negative
	Postcommunist	Negative
Distribution of ability to earn secular income, $g(e|\theta)$	*Income Inequality*	Positive
Overall preference for doctrinal strictness, ρ	*Percent Catholic*	—-
	Percent Protestant	—-
	Percent Muslim	—-
	Country-year random effects	—-
	Regional Fixed effects	—-
	WVS Wave Fixed Effects	—-

Note: '—-' indicates that our theoretical model provides no specific prediction about the sign of the effect of these variables.

Religious Participation and Social Conservatism

Table 2: Theoretical and Empirical Variables in our Analysis of Social Conservatism

	Theoretical Variable	Empirical Variable
Dependent Variables		
	z_i	Social Conservatism
		(i) *Left-Right Ideology*
		(ii) *Divorce*
		(iii) *Euthanasia*
		(iv) *Abortion*
		(v) *Suicide*
		(vi) *Homosexuality*
Independent Variables		
	r_i	*Religious Attendance*
	θ	*Human Development Index*
Control Variables		
		Income
		Male
		Age
		Education
		Country-year random effects
		Regional Fixed effects
		WVS Wave Fixed Effects

$$Social\ Conservatism_{ij} = f(\beta_0 + \beta_1 Individual\ Religious\ Participation_{ij} + \beta_2 Human\ Development\ Index_j$$
$$+ \beta_3 Individual\ Religious\ Attendance \times Human\ Development\ Index_{ij}$$
$$+ \beta_4 Controls_{ij} + \epsilon_{ij}) \tag{2}$$

Table 3: Predictions

Coefficient/Marginal Effect	Prediction
β_1	—-
β_2	Negative
β_3	Positive
$\beta_1 + \beta_3 Human\ Development\ Index$	Positive at all observable levels of HDI
$\beta_2 + \beta_3 Individual\ Religious\ Attendance$	Negative

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