THE (AFTER) LIFE-CYCLE THEORY OF RELIGIOUS CONTRIBUTIONS

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Abstract

We construct and estimate an economic model of religious giving. We employ a dynamic consumer optimization model with mortality in which intra-temporal utility stems from both consumption and religious contributions. Individuals also decide how to allocate resources between religious contributions (which have both a this-life consumption value and an after-life investment value) and other consumption expenditures. If religious contributions do not have an after-life investment value, the ratio of contributions to consumption expenditures should be unrelated to the probability of death. However, if there is an investment value from religious giving, individuals should allocate a greater share of their income to religious contributions as their probability of death increases. We estimate the model using data from the Consumer Expenditure Survey on the consumption and religious contribution patterns of a repeated cross-section of households and of a synthetic cohort panel. We find strong evidence that individuals behave as if religious contributions have a value in the after-life, in a manner consistent with the after life-cycle model. The estimates of the structural parameters of the model also imply that while after-life investment considerations (i.e. impending death) are an important determinant of the life-cycle profile of religious contributions, within-life (i.e. religious consumption) factors pin down a household's average level of religious contributions over a lifetime.

JEL Code: H1, H5, H8.

Keywords: god, life-cycle, consumption, religion, tithing.

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1 Introduction

58 percent of Americans' charitable giving during their lifetimes is directed towards religious organizations, more than the fraction to charitable organizations (33 percent), or political contributions (2 percent).[1] At least some of this behavior likely stems from the United States being a fairly religious country; nearly 9 out of 10 Americans believe in God, more than 4 in 10 attend religious services every week or almost every week.[2] Recently, a growing body of research has resurfaced on the economics of religion. Iannaccone (1998) surveys the issues that have arisen since the seminal paper by Azzi and Ehrenberg (1975) more than thirty years ago. Iannaccone notes that with regards to economic explanations of religious giving, "income and wage effects are almost always dwarfed by those of age, gender and religious upbringing."

While the research to date has much to say on the economic determinants of religious participation, the literature does not easily lend itself to more structural economic interpretations. By construction, the theoretical models are descriptive and, by design, the econometric models are estimated as reduced forms. So, while we may learn that certain socio-economic factors are integral to religious activity, we do not have estimates of economic parameters that we can readily identify. The purpose of our paper is to develop and directly estimate an economic model of religious giving. Our research methodology provides a structural interpretation for religious giving, allowing us to estimate the separate influences of this-life (i.e. consumption) versus concerns about the after-life (i.e. investment).

[1] Based on authors calculations from the Consumer Expenditure Survey (CEX).

[2] The poll was taken January 31 2001 by the Gallup polling organization. Using Michigan Time-Use Studies, Biddle (1992) argues attendance rates are actually 15 percent lower than reported by gallup.

2 Literature Review

The seminal paper in the economics of religion is by Azzi and Ehrenberg (1975). They employ a very simple model in which households choose between economic goods and devotional goods across time. The implications from the model are straightforward: church attendance rises with wealth and falls with income. Correspondingly, as the returns to market activity decline with age, it follows that attendance should rise with age, as the "forces which generate a monotonically declining human-capital investment profile with age will also generate a monotonically increasing 'religious-capital-investment profile' with age." To test their theory they appeal to various survey data, aggregated to the state-level.

Long and Settle (1977), however, challenged their result using individual data from a Wisconsin Survey Research Laboratory. They show that once you include various individual characteristics, then there is less (no) impact of wealth, income and age in determining attendance. In response, Ehrenberg (1977) employed a sample of over 5600 females and their spouses in the 1965 National Fertility Survey to reconfirm their original results: he once again shows how important is age in determining 'religiosity'.[3]

We believe that reconciling alternative driving forces of religiosity has been hampered by a lack of economic formalization. In the preceding literature, preferences are noted to be one of the most important channels through which religion may affect behavior, however, there is less attention to how one might integrate religion into preferences using more recent advances. As age is conjectured to be an important factor in religiosity, it would make sense to appeal to a preference structure that explicitly models intertemporal decision-making. One contribution of our paper is

[3] Given the lack of consensus on the empirical front, another line of the literature has concentrated on formalizing the theory before moving towards the data. For example, in Stark, Iannoccone and Finke (1996) and Montgomery (1996), the focal point of the debate centers on defining how to integrate the concept of 'irrational' religion into a rational framework.

to address this shortcoming in the literature.

Obviously, participating in religious activities goes beyond attendance making it useful to examine how these activities directly impact spending. Dahl and Ransom (1999) surveyed 1200 Mormons to see the importance of one's economic situation on the demand for tithing. They found that financial status alone could not explain the decision to tithe. Gruber (2004) tests the hypothesis that as wages increase religious participation will be reflected to a greater extent through contributions rather than though attendance; using the CEX and the General Social Survey he finds an implied elasticity of attendance with respect to religious giving of -0.9. These results taken together imply that there are other factors that drive religious giving besides income or wealth such as religious participation.

There is an extensive literature on the consequences of religious participation, surveyed in Iannaccone (1998). Additional new contributions on the economics of religiosity include the following: Glaeser et al (2005) present an information-based model of religious extremism. They show that political parties will adopt relatively extreme religious positions in their platforms in order to increase turnout among party members. This strategic extremism is largest when close to 50 percent of the population is religious. Barro and McCleary (2003) argue that there is a causal link between economic growth and religious attendance and belief. Gruber (2005) finds that increased religious participation leads to higher educational attainment and income, less dependence on social insurance programs and higher rates of marriage. Jeitschko, OConnell, and Pecchenino (2005) develop a model in which spirituality – determined by both tithing and other religious activities – can increase both mental and physical health. Dehejia, DeLeire, and Luttmer (2005) find that households who participate in religious organizations are better able to smooth consumption after experiencing declines in income.

Given these links, and the fact that the literature on religious attendance points to age as an important determinant, one would imagine that there should be a general model of religious over the life-cycle giving in which age related factors is a deciding factor. The purpose of our paper is to build such a model, estimate it, and interpret the economic consequences for religiosity. We begin with a simple intertemporal utility maximization problem in which households allocate spending between economic and religious activities. We introduce the ability to store religiosity over time and a varying probability of survival. In particular, individuals can obtain utility from enjoying the benefits of religious giving in this life (i.e. consumption) and in the next (i.e. investment).

We use data from the Consumer Expenditure Survey (CEX) to estimate our model. The CEX data is ideal for our analysis because it allows us to identify important changes and significant trends in American consumer spending and compare these to changes in religious giving. The Bureau of Labor Statistics surveyed over 300,000 different families between 1982 and 1998 on their detailed expenditures (including religious contributions). We both employ this micro-level data directly and similar data from the General Social Survey (GSS) which contains comprehensive data on social issues, intergroup relations and religion. We use the CEX and GSS together to create a synthetic cohort panel on which to also estimate our model. Importantly, we can estimate our model's key parameters both using the household-level data and the synthetic cohort panel.

The results from our empirical work confirm the previous research that highlights the importance of economic factors in influencing religiosity, even after controlling for individual and time specific factors. But more to the point, we are able to extract structural parameters from our model that allow us to quantify the relevant importance of giving as a consumption good versus giving as an investment good. The remainder of the paper is organized as follows: Section 3 of the paper provides a description of our theoretical model, while Section 4 provides simulations to describe the model's life cycle implications for religious giving. Section 5 provides a description of our data and the methodology we employ in Section 6, our empirical section. Finally, we provide concluding remarks in Section 7.

3 Theory

In this section, we develop our theoretical model that we test in the ensuing sections. The theoretical model follows the standard model of life-cycle consumption with three notable differences. First, we allow for the possibility that the stock of religious contributions can be stored and provide value after death. Second, we explicitly model the probability of survival. Finally, unlike Azzi and Ehrenberg (1975), we focus on expenditures rather than time considerations in religious activity.

We begin by describing the preferences of individuals. Individuals derive utility through consumption of market goods and through being a financially contributing member of a religious organization. Individual i derives utility, U, through the flow of private consumption, c, and their stock of contributions, s, in the current period t:

$$U_{it} = U(c_{it}, s_{it}) \tag{1}$$

where $U_c > 0$, $U_{cc} < 0$; $U_s > 0$; $U_{ss} < 0$; $U_{cs} < 0$.

The flow of religious contributions, τ_{it}, can be stored each period in the stock of contributions, s_{it}, such that the dynamics of the stock of religious contributions is given by:

$$s_{it} = \delta \cdot s_{it-1} + \tau_{it} \tag{2}$$

The term δ captures the effect of net depreciation on past religious contributions. Note that if $\delta = 0$, then there is no storage and in each period the stock of religious contributions will be equal to tithing in that period. Alternatively, if $\delta = 1$, then the individual's accumulated stock of contributions is equal to their lifetime sum of religious giving.[4] The stock of contributions, s_{it}, along with private consumption, c_{it}, contribute to within lifetime utility.

Tithing over the individual's lifetime has some additional benefit as the stock of contributions has some 'after-life' value, Ω, in the event the individual dies where:

$$\Omega_{it} = \Omega(s_{it}) \tag{3}$$

where $\Omega' > 0$ and $\Omega'' < 0$. There is some probability P_{it+1} that the individual will not survive from today, period t, until next period, period $t+1$. Therefore, conditional on being alive at time t, individual i at period t has the following preference function:

$$U(c_{it}, s_{it}) + P_{it+1} \cdot \Omega(s_{it}) \tag{4}$$

where P_{it+1} is the i^{th} individual's probability of dying before making it to period $t+1$, conditional on having survived until period t. Importantly, religious contributions provide benefits both in this life, $U(.)$ and the next, $\Omega(.)$. Accordingly, from the perspective of time period zero, for any given period t the individual i has the following preference function:

$$\Phi_{it} \cdot U(c_{it}, s_{it}) + \Sigma_{it+1} \cdot \Omega(s_{it}) \tag{5}$$

where Φ_{it} is the unconditional probability that individual i is alive at time t and Σ_{it+1} is the unconditional probability that the individual dies at the beginning of (i.e. before making it to) time period $t+1$. Note that since P_{it} is the probability that the individual dies in period t, the probability that he is alive at time t is $\Phi_{it} \equiv \Pi_{j=0}^{t}(1 - P_{ij})$.[5] Also note that unconditional

[4] Historically speaking, another motivation for this specification would be the Catholic Church's adoption of indulgences which were sold as a way to purchase the forgiveness of sins and/or reduce time in Purgatory. They were started during the reigns of Popes Pascal I (817-824) and John VIII (872-882) as a way of generating revenue, but became a focal point of criticism during the Reformation. In 1567 Pope Pius V cancelled all grants of indulgences involving any fees or other financial transactions.

[5] It follows that the individual is alive at time 0, so that $P_{i0} = 0$ and $\Phi_{i0} = 1$.

probability that the individual dies at beginning of (i.e. before making it to) time period $t+1$ is $\Sigma_{it+1} \equiv \Phi_{it} \cdot P_{it+1}$.

The individual chooses a path for next period's wealth (W_{it+1}) and their current stock of contributions (s_{it}) by choosing a sequence of consumption of goods (c_{it}) and religious contributions (τ_{it}) to maximize their expected utility in this life and in the next:

$$\max_{\{c_{it}, s_{it}\}} \quad \sum_{t=0}^{\infty} \beta^t \left[\Phi_{it} \cdot U(c_{it}, s_{it}) + \Sigma_{it+1} \cdot \Omega(s_{it}) \right] \tag{6}$$

According to expression (6), the first term describes that the individual maximizes his discounted expected utility from consuming non-religious goods, c_{it} and his stock of contributions, s_{it}, in this life. The second term denotes that the individual also takes into account the expected payoff (i.e. the salvage/salvation value) from the stock of religious contributions at time t, $\Omega(s_{it})$, if he were, having survived until period t, to die before making it to time period $t+1$. This occurs with probability Σ_{it+1}. To complete the problem, the individual maximizes expression (6) subject to the stock of contributions (2) and wealth equations:

$$W_{it+1} = R(W_{it} + y_{it} - c_{it} - \tau_{it}) \tag{7}$$

where $W_{i0} > 0$ and $s_{i-1} = 0$. Expression (7) is the standard intertemporal wealth constraint where W_{it} is the stock of wealth held by individual i at the start of period t, y_{it} is his or her period t labor income, and spending takes the form of non-religious spending, c_{it} and religious contributions, τ_{it}. The gross rate of return on wealth is equal to R.

Iterating the wealth constraint (7) forward, substituting out τ_{it} using expression (2), and imposing the standard transversality conditions, we can write the constrained optimization problem as:

$$\sum_{t=0}^{\infty} \beta^t \left\{ \Phi_{it} \cdot U(c_{it}, s_{it}) + \Sigma_{it+1} \cdot \Omega(s_{it}) \right\} + \lambda \left[W_{i0} + \sum_{t=0}^{\infty} R^{-t} \left(y_{it} - c_{it} - s_{it} + \delta s_{it-1} \right) \right] \tag{8}$$

where λ is the shadow value of wealth. The intertemporal optimality equations for the optimal choice of c_{it} and s_{it} are, respectively:

$$\beta^t \Phi_{it} U_{c_{it}} = \lambda \cdot R^{-t} \tag{9}$$

$$\beta^t (\Phi_{it} U_{s_{it}} + \Sigma_{it+1} \Omega'(s_{it})) = \lambda \cdot R^{-t} \cdot (1 - (\delta/R)) \tag{10}$$

where $\delta/R < 1$. Expression (9) is a slightly modified version of the standard equation for the marginal utility of wealth. Plugging expression (9) into (10) and re-arranging yields:

$$U_{s_{it}}/U_{c_{it}} + P_{it+1}\Omega'(s_{it})/U_{c_{it}} = 1 - (\delta/R) \tag{11}$$

Expression (11) tells us that individuals will balance the mortality adjusted marginal utility of religious contributions (that affect both period t utility and after-life utility) with the marginal utility of consumption (that only affects current period utility). This equation also yields two intuitive implications.

First, the extra term of the marginal value of religious contributions to utility through its (mortality adjusted) effect on the after-life value means that the marginal utility of consumption needs to be higher (that is, consumption needs to be lower and contributions to be higher) in every period than if $\Omega(s_{it})$ were zero. That is, if religious contributions have both an investment value and a consumption value, contributions will be greater and consumption of market goods will be less than if religious contributions had only a consumption value.

Second, as the probability of death increases (that is, the term, P_{it+1} gets larger) the marginal utility of religious contributions through its affect on the after-life value gets larger. In response and to compensate, the marginal value of consumption must rise (that is, consumption must fall and contributions must increase). Thus, *ceteris paribus*, as the probability of death increases, the ratio of religious contributions to consumption will increase.

We now parameterize the utility function as: $U(c_{it}, s_{it}) = log(c_{it}) + \alpha \cdot log(s_{it})$ as well as the salvage value of the stock of contributions at the time of death, namely $\Omega(s_{it}) = \Omega \cdot log(s_{it})$. Using these functional forms in expression (11) and re-arranging we obtain:

$$s_{it}/c_{it} = [1 - (\delta/R)]^{-1} [\alpha + \Omega \cdot P_{it+1}] \qquad (12)$$

Intuitively, the individual accumulates a larger stock of contributions *vis-a-vis* his consumption expenditures if his probability of death rises (P_{it+1}), if he values his stock of religious contributions more in this life (α) or in the next life (Ω), and as the relative rate of return for accumulating the stock of religious contributions rises *vis-a-vis* accumulating wealth (δ/R).

Unfortunately, unless we make a number of additional assumptions, we cannot estimate expression (12). For instance, since we do not directly observe s_{it}, we could make the strong assumptions that $\delta = 1$ and that we observe an individual or cohorts entire lifetime path of religious contributions in order to construct a series for s_{it} as the sum of all past τ_{it}'s. However, rather than make such rigid assumptions, we can also derive an equation relating the flow of religious contributions to other observable variables. For instance, we can re-arrange (12) to obtain:

$$s_{it} = [1 - (\delta/R)]^{-1} [\alpha + \Omega \cdot P_{it+1}] \, c_{it} \qquad (13)$$

The lagged expression of (13) is:

$$s_{it-1} = [1 - (\delta/R)]^{-1} [\alpha + \Omega \cdot P_{it}] \, c_{it-1} \qquad (14)$$

Subtracting expression (14) from (13) using (2) we obtain:

$$\tau_{it} = [1 - (\delta/R)]^{-1} [(\alpha + \Omega P_{it+1})c_{it} - \delta(\alpha + \Omega P_{it})c_{it-1}] \qquad (15)$$

Dividing through both sides by c_{it} and using the intertemporal consumption optimality condition that $c_{it-1}^{-1} = \beta R(1-P_{it})c_{it}^{-1}$ yields:[6]

$$\tau_{it}/c_{it} = [1-(\delta/R)]^{-1}\left[\alpha + \Omega P_{it+1} - \frac{(\delta/R)(\alpha+\Omega P_{it})}{\beta(1-P_{it})}\right] \tag{16}$$

Again, the intuition for expression (16) follows closely that of expression (12): namely, the individual contributes more *vis-a-vis* his consumption expenditures if his probability of death rises (P_{it+1}), if he values his stock of religious contributions more in this life (α) or in the next life (Ω), and as the relative rate of return for accumulating the stock of religious contributions rises *vis-a-vis* accumulating wealth (δ/R).

The expression for the tithing ratio, τ/c, is clearly non-linear in the parameters, α, Ω and δ/R, as well as the probability of death. To better clarify the relationship, using the fact that $1/(1-P_{it}) = 1 + (P_{it}/(1-P_{it}))$, expression (16) becomes:

$$\tau_{it}/c_{it} = [1-(\delta/R)]^{-1}\left[\alpha\left(1-\frac{\delta/R}{\beta}\right) + \Omega P_{it+1} - (\alpha+\Omega)\left(\frac{\delta/R}{\beta}\right)\left(\frac{P_{it}}{1-P_{it}}\right)\right] \tag{17}$$

Notice that the coefficient on P_{it+1} is positive, while that on $P_{it}/1-P_{it}$ is negative.

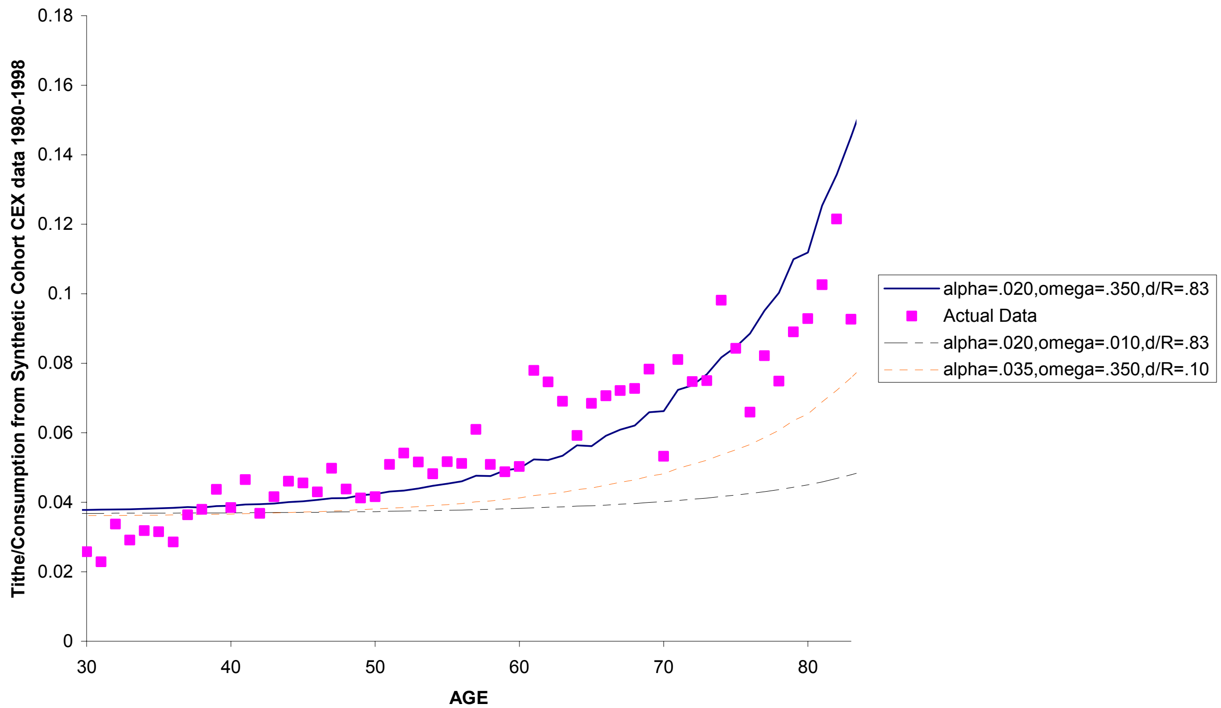
4 Simulations

To more closely examine the model's implications for religious contributions, we specify functional forms, and parameter values to trace out the predicted life-cycle patterns for consumption and religious contributions under alternative scenarios. First, we begin with the case where individuals value religiosity (i.e. there is a current period utility value of religious contributions), they value the 'after-life' of past contributions (i.e. investment), and they can accumulate religious contributions over time (i.e. the rate of depreciation of these contributions is low).

Figure 1 plots the cohort life-cycle path of the religious contribution to consumption ratio using the CEX data as well as the simulated life cycle paths from expression (17) – see section 5

[6]This latter condition is just the intertemporal consumption smoothing expression, for log utility, derived from expressing (9) at time $t-1$ and t and combining terms.

Figure 1: Tithing/Consumption Age Profiles



for a description of the data and cohort methods.[7] We begin by describing the actual data. The tithing measure (i.e. the religious contribution to consumption ratio) starts at just under 3 percent per year when a cohort is 30 years old and rises four-fold to over 10 percent by the time a cohort is in its mid-80's.

The simulated life-cycle profiles obviously depend on the underlying structural parameters, α, Ω and δ/R as well as the probability of death.[8] We consider three combinations of parameter values to highlight their relative contribution to the life cycle paths. In case 1, contributions by individuals are primarily an investment in the after-life. In this case, we set $\alpha = 0.02$, $\Omega = 0.350$ and $\delta/R = 0.83 = 0.875/1.05$. Notice that the simulated path provides a reasonable fit of the data. In contrast, in case 2 contributions are not as useful an investment in the after-life. For this case, we significantly reduce Ω to $\Omega = 0.01$. Accordingly, the ratio of tithing to consumption is much flatter than in either case 2 or in the actual data. Hence, as demonstrated in expression (17), Ω is an important variable in determining the steepness of the tithing profile. Finally, in case 3, individuals have a tremendously reduced ability to store the stock of religious contributions. We do this by setting $\delta/R = 0.1$. We return the value of Ω to 0.350 though we increase the value of α in order to reasonably match the simulated tithing ratio to the data at age 30.[9] Note that again, with a reduced value for δ/R, the slope of the tithing profile for case 3 in Figure 1 is flatter.

In summary, two things are likely to be important in terms of matching the data. First, the investment aspect of religious giving must be relatively important in the life-cycle (i.e. as the probability of death rises) as compared to the consumption aspect of religious giving in order to

[7] The data used in Figure 1 are based on data averaged over all cohorts.

[8] Note that in all the simulations, we set $\beta = .95$. The death probabilities were obtained from the Berkeley Mortality Database (2002). These data are based on life tables constructed by the Office of the Actuary of the Social Security Administration. The probability of death data used in Figure 1 are based on the average probability of death across all cohorts.

[9] Again, as expression (17) indicates, α has a strong influence on the tithing ratio when the probabilities of death are small. Indeed, with $\beta = 1$, α is the tithing rate with a zero probability of death.

explain the steepness of the tithing profile. Second, an important feature to giving must be that there is some storage value to holiness via the lifetime stock of religious contributions. We next turn to our data from the CEX and estimate our (after) life-cycle model of religious contributions.

5 Data and Methods

In this section, we describe the data employed in the paper and how we estimate the model we developed in the preceding section.

5.1 Data and Descriptive Statistics

In this sub-section we present a descriptive data analysis to compare our results to previous research and data. As we will see below, families from the Midwest and South, with more education, higher income, larger families spend more on religious activities than other families. Importantly, religious giving also appears to increase with age in a fundamentally different manner than other types of related spending such as spending on charitable activities and on political campaigns.

The data for this study came from the Consumer Expenditure Survey (CEX), which was developed to provide information on consumer behavior. We use data from the 1982 through 1998 panels of the CEX.[10] The CEX is a nationally representative survey of roughly 5,000 households per year, is the basic source of data for the construction of the items and weights in the market basket of consumer purchases to be priced for the Consumer Price Index, and is widely regarded as the best source of U.S. consumption expenditure data. It contains information on the income and demographic characteristics of the household as well as detailed household-level information on expenditures. Each household is interviewed up to four times at three-month intervals and three months of expenditure data are collected retrospectively at each quarterly interview. Income over

[10] Our data set ends in 1998 due to the following two constraints. First, the religious contributions question on the CEX was changed after the late 1990's, and thus made the pre-change responses incomparable to post-change ones. As well, the General Social Survey was taken only in even years after 1998.

the past 12 months is asked in the first and last interviews. In the last interview, data on five types of contributions over the past year are collected. These are contributions to religious organizations, charitable organizations, political organizations, educational organizations, and miscellaneous contributions.[11] Our measure of total consumption is based on the expenditure data reported in the CEX; consumption of goods provided in-kind is not measured in the Consumer Expenditure Survey and is therefore excluded from our measure of consumption. The CEX, therefore, provides a richly detailed data source to test the implications of our theory.

There are several limitations to directly employing the CEX data to address all of the empirical implications directly related to our model. For example, the CEX does not ask questions relating to religious affiliation which have been shown to have strong explanatory power in determining religiosity [see Innaconne (1998)]. In order to examine this role, we include religious denominations in our data by linking the CEX data to cross-sections of the General Social Survey (GSS) using synthetic cohort data analysis. As a robustness check, we then compare these results to estimates using the CEX micro-level data which excludes religious denominations but includes additional important demographic information. As we demonstrate below, the results for the estimated structural parameters are consistent across the two estimation strategies.

The GSS contains religious, demographic and sociological information on 38,116 households from 1982 to 1998. We create cohort-level variables in both datasets and then merge them by birth cohort (decade of birth), ethnicity (white and non-white), education (less than high school, high school graduate, some college), and region (West, Midwest, South and Northeast). The resulting synthetic cohort panel data is thus given as:

$$\text{birth cohorts*ethnicity*education*region*year} = 7 * 2 * 3 * 4 * 18 = 3024.$$

[11] About 40 percent of households make a contribution to a religious organization and these contributions represent about 1.2 percent of household income in the CEX. These findings are consistent with other sources (according to Iannaccone 1998, total religious contributions represent roughly 1 percent of GNP).

However, as some birth cohorts are not present in each year of our sample and because the GSS does not have religious affiliation data for all years of the CEX sample, we have an unbalanced panel of over 1,600 observations.[12] It is also important to note that the sample size of the GSS is not large enough to allow for variation at the region level, though religious affiliations in the cohort sample do vary by birth cohort, ethnicity, education, and year.

Table 1 provides summary statistics (means and standard deviations) from the micro-level household CEX data. Each column represents a different variable in the dataset – level of real consumption (in 1998 dollars), level of religious giving, annual income, and tithing (religious contributions as a percent of total non-religious consumption), and the number of observations in each row. Each row provides a different parsing of the data, e.g. by those that gave some amount (GIVERS), those with income greater than average (RICH), etc. There are three empirical regularities. First, for those that give a positive amount, 'GIVERS' tithe about 3.6 percent of their total consumption compared with 1.4 percent for all households. Second, those with above average income (i.e. the 'RICH') only give a slightly greater portion of their income. Third, households headed by people over the age of 60 tithe a greater share than do younger households.

As demonstrated by the theory, a primary determinant of religious giving is the likelihood of death. For our study, the death probabilities were obtained from the Berkeley Mortality Database (2002). These data are based on life tables constructed by the Office of the Actuary of the Social Security Administration (SSA) and vary across year and cohort. We then use the relative mortality factors from Brown, Liebman, and Pollet (2002) to adjust these data and create death probabilties

[12]It is important to note that parsing the data by education, ethnicity, region and year does not qualitatively impact our empirical results. We considered three other alternative parsings — first, creating synthetic cohorts based on decade of birth using *only* the CEX; second, linking this to GSS data and including religious denominations; and finally, linking the GSS to CEX by birth cohort, education and race (i.e. not by region). In each case our general results were similar to those described below.

Table 1: Basic Micro-level Statistics 1982-1998
(1998 CONSTANT DOLLARS)

GROUP	CONSUMPTION	GIVING	INCOME	TITHE	NOBS
TOTAL	32,841	412	32,392	0.014	87,781
(s.d.)	33,006	1,393	31,349	0.048	
ALL GIVERS	38,172	1,101	39,767	0.036	32,698
(s.d.)	35,398	2,104	33,073	0.072	
RICH	47,754	671	61,406	0.016	33,321
(s.d.)	38,732	1,813	30,633	0.058	
BLACK	21,936	327	21,505	0.014	9,386
(s.d.)	19,695	1,119	22,663	0.035	
$29 < AGE < 61$	40,591	518	41,114	0.013	34,118
(s.d.)	37,443	1,670	36,191	0.035	
$AGE > 60$	24,763	493	22,850	0.022	21,461
(s.d.)	27,485	1,444	29,323	0.076	
FAMSIZE3	37,952	436	38,186	0.012	13,907
(s.d.)	33,528	1,448	33,019	0.032	
FAMSIZE4	43,756	489	43,516	0.012	12,566
(s.d.)	38,768	1,338	35,423	0.029	
MARRIED	41,277	576	41,620	0.016	49,722
(s.d.)	37,754	1,703	34,775	0.054	

Notes: Each column reports average real consumption, religious contributions (GIVING), income and tithe (GIVING/CONSUMPTION) with associated standard deviation (s.d.) and number of observations (NOBS). Each row provides a different parsing of the data: TOTAL provides data for entire sample, ALL GIVERS provide data for those with positive religious contributions, and RICH provides data for those with above average income. $29 < AGE < 61$ and $AGE > 60$ provides data for heads of households in that age bracket, MARRIED and BLACK provides data for those heads of households who so designate these categories, and FAMSIZE3 and FAMSIZE4 provides data for those with family sizes of 3 and 4, respectively. Data are in 1998 Constant Dollars.

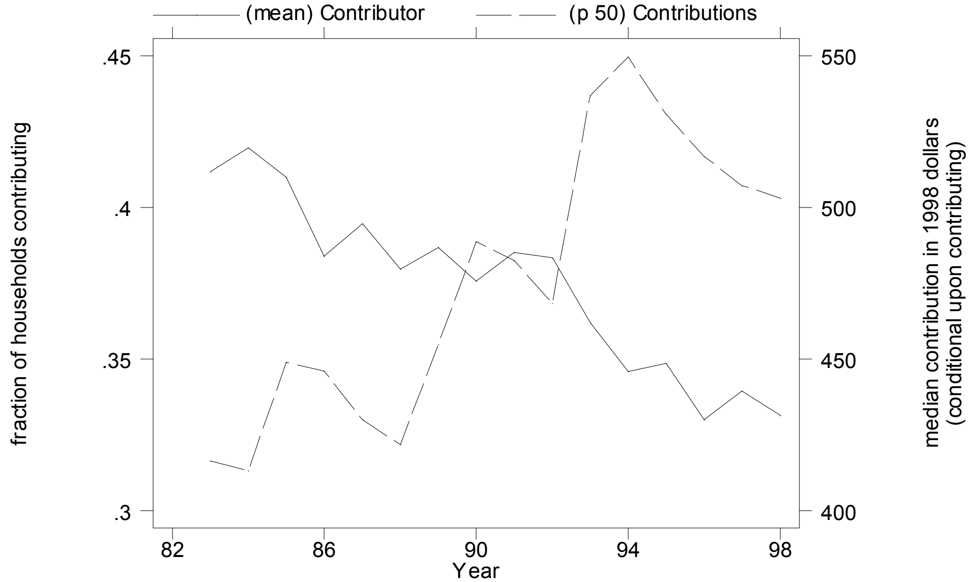
that vary by year, cohort, race, and education level. Note that the life tables yield the probability that a person of a certain age will have died in a particular year–between the ages 29-88. While separate lifetables by sex are available, we do not use them because the only gender information we have is for the head of household, which is not particularly useful as a measure of gender for this study.[13] A description of the methodology used to construct the SSA tables can be found in Bell, *et al* (1992).

Our next step was to ensure that our data are consistent with that in other data sets. We are also interested in seeing what sorts of phenomena we were able to observe in our data that was unavailable in some of the other studies. To examine and compare our data, Figure 2 plots the mean contribution and fraction of households contributing to religious organizations from 1982 to 1998. Two facts can be gleaned from Figure 2. First, both the magnitude of giving (a median contribution of around $450 per year) and the percent of families that give (around 40 percent) are large. These numbers are not inconsistent with what others have reported. Hrung (2004) uses the 1999 survey of Giving and Volunteering in the United States and reports that the average annual religious contributions was $465 which was more than double that of non-religious giving. Second, while the percent of families that give has declined over time, the magnitude of giving among givers has actually increased in real terms during the same time period.

Figure 3 plots the fraction of households contributing and median contributions versus a variety of factors that have been found to significantly impact religiosity. The top left panel plots religious giving against income, the top right panel plots religious giving against education, the bottom left panel plots religious giving against family size and the bottom right panel plots religious giving against age. Figure 3 demonstrates that there appears to be a strongly positive and linear relationship between income, education, family size and giving. Figure 3 also demonstrates

[13] Note that the results are unaffected if one include these gender based lifetables.

Figure 2: Religious Contributions 1982-1998



Fraction Contributing and Median Contributions Over Time that there is a strongly positive relationship between age and giving. Interestingly, there appears to be a slight difference here between the amount and percent of giving once households turn 60. A greater fraction of the oldest households make religious contributions, albeit at a lower amount.

The results demonstrated by Figure 3 are consistent with what others have found. Innaconne (1998) employs cross-sections of the General Social Survey from 1986 to 1990 to demonstrate a similar result - giving is positively and statistically significantly correlated with education, income, family size and age. In summary, our data appears to be highly consistent with other data in the household religiosity literature.

Given the strong similarities in our data to other data and the richness of the CEX questionnaire, we decided to employ a variety of variables in our analysis that have not been explored in some of the other work. As a preliminary check on our data, we have examined consumption components varied by age. One of our central conjectures is that as individuals age, they are more likely to be religious (or at least raise their religious contribution as a ratio to their total consumption) as they their proximity to a possible afterlife increases. Hence, our theory implies that if individuals are concerned with the after-life, consumption of religious activities should increase with age.

Figure 4 plots total expenditure and relevant subcategories using our synthetic cohort data. Each line in the panels represent a different birth cohort. The top panels report consumption with discretionary subcategories that have been found to follow similar patterns. The top left panel plots total expenditure, the top middle panel plots entertainment and the top right panel plots 'sin' expenditure (alcohol and tobacco). The bottom panels report religious contributions next to other types of contributions that one might, *a priori*, believe to be of similar ilk - charitable contributions and political contributions.[14]

[14]One can consider the following question: "Would you rather give an extra dollar to a political party on the day

Figure 3: Religious Contributions vs. Various Factors 1982-1998

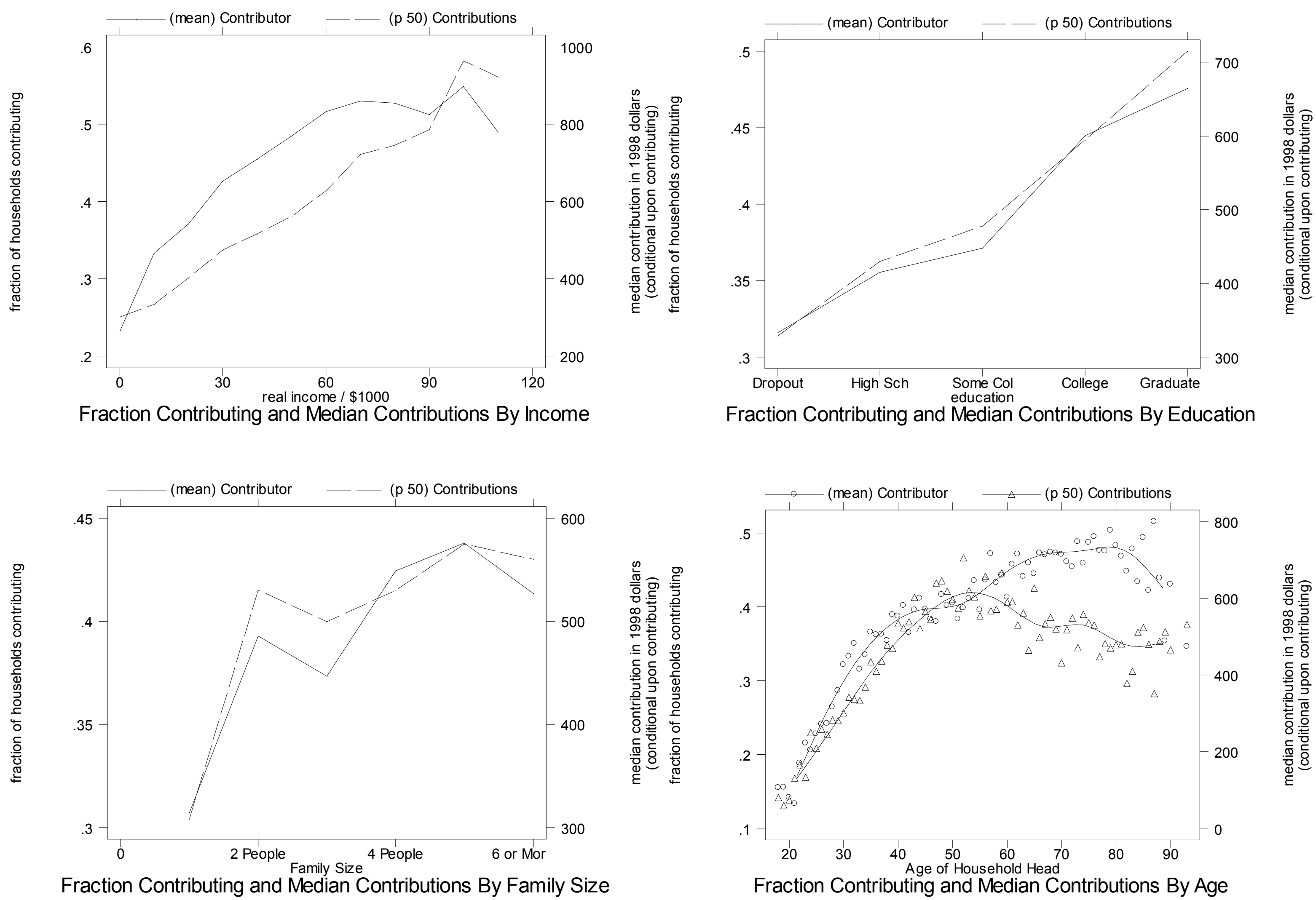
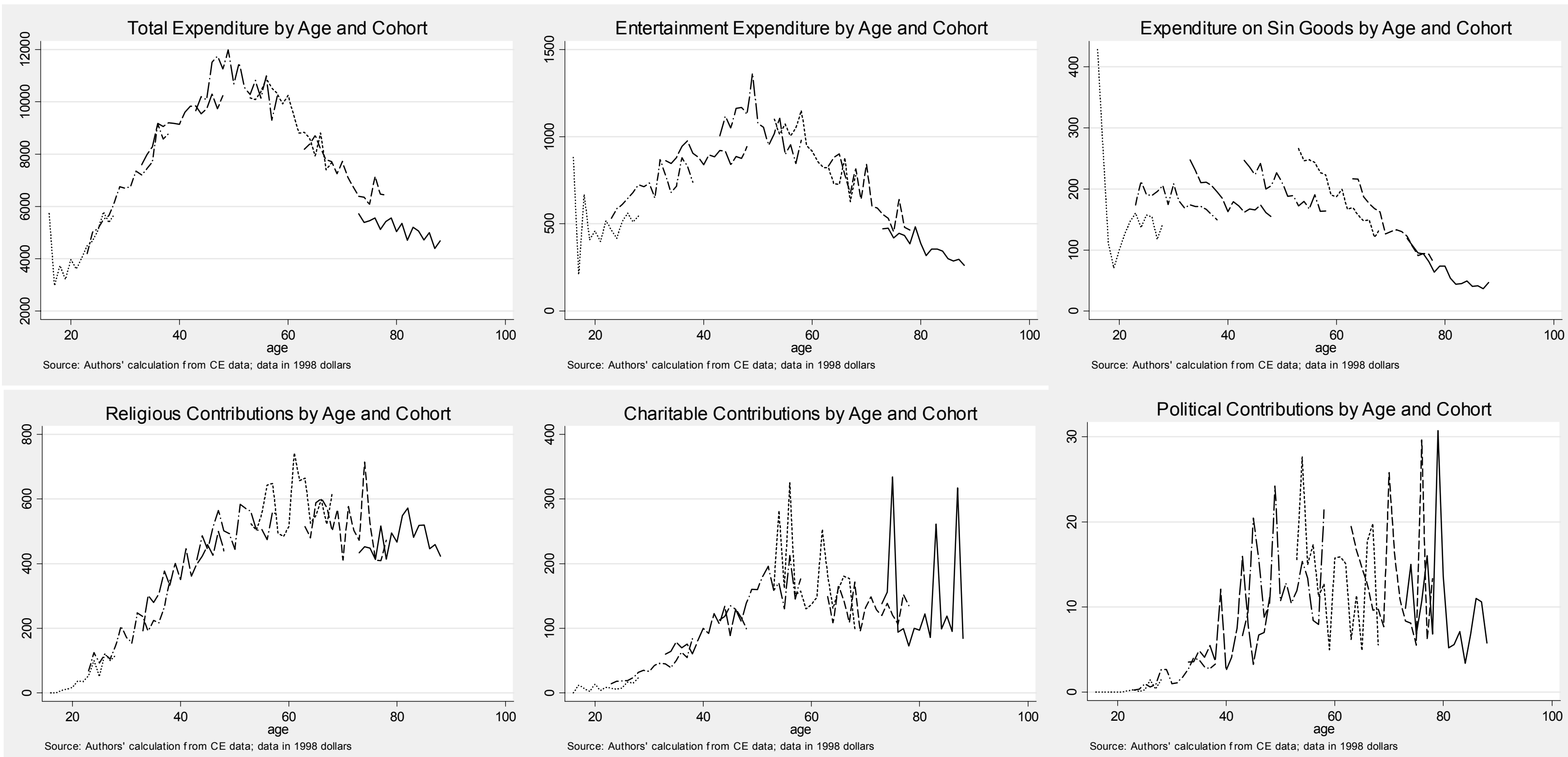


Figure 4: Consumption Expenditure and Subcategories 1982-1998



The top panels demonstrate the traditional 'hump-shaped' life-cycle profile of consumption. That is, consumption increases over one's life-cycle until around the age of 45 to 50, then, household consumption begins a steady descent until death. The top left panel demonstrates this pattern for total consumption whereas the middle panel demonstrates this pattern for entertainment expenditures. 'Sin goods' (alcohol and tobacco) decline with age though there appears to be substantial cohort effect (with younger cohorts consuming less alcohol and tobacco).

Alternatively, the bottom panels of the figure show some differences that we believe have something important to say about household's religiosity. Religious contributions do not in fact decline around the age of 45 to 50. In fact, religious contributions continue to rise over time until households reach retirement age. Once into retirement, there is only a slight decline in religious giving - far less pronounced than what is seen in the top panels. The bottom middle and bottom right panels plot what are likely close substitutes to religious giving - charitable contributions and political contributions. These panels demonstrate a similar 'hump-shape' to the above panels, although the data appears to be a bit noisier given that the dollar amount of each is smaller than total consumption or entertainment consumption. Still, these panels demonstrate that both charitable contributions and political contributions begin to fall around the age of 45 to 50, following paths more similar to total consumption than consumption of religious goods.

While these empirical regularities are important for understanding the gross features of the data, in what follows we investigate the empirical relevance of our theory. We next turn to our data from the CEX and estimate our (after) life-cycle model of religious contributions.

In the next two sub-sections, we provide estimates of the model's key parameters using a number of different approaches. As shown below, these alternative estimates have a number of common features which indicate strongly the extent to which religious giving is tied to after-life

before your death, or to a religious organization?"

consumption.

5.2 Estimation Using the Synthetic Cohort Panel

Our first approach to estimating the life-cycle of religious contributions is to use the synthetic cohort panel. A distinct advantage to this approach is that we have some data at the cohort level which we do not have at the individual level. Importantly, we also need to control for cohort characteristics that vary over the life-cycle such as family size and number of children. We follow Attanasio and Weber (1995) and add a set of controls for family size and composition that will vary by cohort over the life-cycle.[15]

The results in Table 2 described below use the cohort level data to estimate the tithing (flow) relationship embodied in expression (17). The major benefit to this approach is that not only can we estimate α and Ω, but we can also estimate δ/R. Following equation (17), the results in Table 2 are the empirical estimates from the following specification:

$$\tau_{it}/c_{it} = b_0 + b_1 \cdot P_{it+1} + b_2 \cdot P_{it}/(1 - P_{it}) + \zeta X_{ti} + \varepsilon_{it} \tag{18}$$

$$b_0 = \alpha\left[1 - (\delta/R)\right]^{-1}\left[1 - (\delta/R\beta)\right], \quad b_1 = \Omega\left[1 - (\delta/R)\right]^{-1}, \quad b_2 = -(\alpha + \Omega)\left[1 - (\delta/R)\right](\delta/(R\beta))$$

After obtaining estimates of b_0, b_1 and b_2 and setting the value for β, these three equations are non-linear functions of the three unknowns: α, Ω and δ/R.[16] The estimated reduced form coefficients and the structural coefficients are presented in Table 2.[17] The estimates in column (I) provide a stripped down regression where no additional variables are included other than those indicated by the theory. The remaining columns include additional demographic variables for other demographic characteristics: in column (II) we include measures for the percentage of the

[15] Note that given the linear structure of expression (12), these controls will imply shifts in the preference parameter for α if we were able to observe the stock of contributions. This will not be true, however, for the non-linear expressions (16) and (17).

[16] Note that given the estimates of the reduced form parameters, there are two solutions to δ/R: one estimate is greater than one and the other is less than one. Following the theory we choose the estimate below one.

[17] The standard errors for the structural coefficients are obtained using the delta method.

cohort*ethnicity*education*region*year cell that is married (MARRIED), whereas in column (III) we include measures of family size. These latter variables are the percent of three-member families in the cell (FAMSIZE3) and the percent of four-member families in the cell (FAMSIZE4). In column (IV) we include variables for religious affiliation, namely, the percent of individuals who are Catholic in the cohort*ethnicity*education*year (CATHOLIC), the percent who are Jewish (JEWISH), the percent who are protestant (PROTESTANT), and the percent who are conservative protestant (CONS. PROT.) In column (V) all these variables are included and finally in column (VI) the log of average income in the cell, log(Y), is included as an additional explanatory factor to proxy for any liquidity constraints which may affect the estimates of our deep parameters.[18]

There are a number of important findings reported in Table 2. First, as indicated by the theory, the estimated coefficient on P_{it+1}, b_1 is positive and the coefficient on $P_t/(1-P_t)$, b_2, is negative. Also, in all specifications, the estimated reduced form coefficients b_1 and b_2 are statistically significant at or below the 0.1 level. Second, from these reduced form estimates, the estimates of the structural parameters are all generally statistically significant at or below the 1 percent level. Moreover, the estimates tend to vary in a relatively narrow range across specifications. Roughly speaking, the estimates of α, Ω and δ/R are approximately 0.01, 0.4 and 0.84., respectively. These estimates, not surprisingly, correspond closely to those used in generating the simulations for Case 1 displayed in Figure 1. Recall that Case 1 best fit the data and implied that households make religious contributions at least in part because of their after-life (investment) value.

[18]Note that in the estimation procedure, the data are weighted by cell-size and the standard errors are clustered at the cohort, education and race level (i.e. $7 \times 3 \times 2 = 42$ clusters). Due to the latter, we do not include fixed effects. Year effects are possible but do not affect the estimate of the main parameters of interest.

Table 2: Flow of Giving Cohort Regression: 1982-1998

$$\tau_{it}/c_{it} = b_0 + b_1 \cdot P_{it+1} + b_2 \cdot P_{it}/(1-P_{it}) + \zeta X_{ti} + \varepsilon_{it}$$
$$b_0 = \alpha\left[1-(\delta/R)\right]^{-1}\left[1-(\delta/R\beta)\right], \quad b_1 = \Omega\left[1-(\delta/R)\right]^{-1}, \quad b_2 = -(\alpha+\Omega)\left[1-(\delta/R)\right](\delta/(R\beta))$$

	(I)	(II)	(III)	(IV)	(V)	(VI)
Constant	0.010^{***}	0.004	0.010^{***}	0.002	0.001	-0.001
	[0.001]	[0.003]	[0.002]	[0.005]	[0.005]	[0.005]
P_{it+1}	3.044^{**}	3.012^{**}	2.734^{**}	2.499^{**}	2.139^{**}	2.295^{**}
	[1.310]	[1.287]	[1.180]	[1.158]	[1.007]	[1.001]
$P_{it+1}/(1-P_{it+1})$	-2.638^{**}	-2.582^{**}	-2.359^{**}	-2.154^{*}	-1.818^{*}	-1.959^{**}
	[1.214]	[1.190]	[1.098]	[1.071]	[0.938]	[0.933]
FAMSIZE3			0.000		-0.001	-0.001
			[0.001]		[0.001]	[0.001]
FAMSIZE4			-0.001		-0.001	-0.001
			[0.002]		[0.002]	[0.002]
MARRIED		0.002			0.002	0.000
		[0.004]			[0.004]	[0.004]
CATHOLIC				0.004	0.002	0.004
				[0.006]	[0.005]	[0.005]
JEWISH				0.058^{***}	0.051^{***}	0.036^{**}
				[0.012]	[0.013]	[0.014]
PROTESTANT				0.012^{**}	0.011^{**}	0.016^{***}
				[0.005]	[0.005]	[0.005]
CONS. PROT				-0.013^{**}	-0.013^{**}	-0.011^{**}
				[0.006]	[0.006]	[0.005]
log(Y)						0.004^{***}
						[0.001]
δ/R	0.832^{***}	0.832^{***}	0.826^{***}	0.840^{***}	0.831^{***}	0.839^{***}
	[0.029]	[0.031]	[0.033]	[0.033]	[0.040]	[0.035]
Ω	0.511^{***}	0.505^{***}	0.477^{***}	0.399^{***}	0.361^{***}	0.368^{***}
	[0.132]	[0.125]	[0.119]	[0.114]	[0.098]	[0.095]
α	0.011^{***}	0.005	0.011^{***}	0.002	0.001	-0.001
	[0.001]	[0.003]	[0.002]	[0.005]	[0.005]	[0.005]
Observations	1623	1623	1623	1623	1623	1623
R-squared	0.17	0.18	0.17	0.20	0.20	0.21

See Notes: See Table 1. ***, ** and * represent statistical significance at the .01, .05 and .10 levels, respectively. The estimated standard errors are presented in parentheses. Note that in the estimation procedure, the data are weighted by cell-size and the standard errors are clustered at the cohort, education and race level (i.e. $7 \times 3 \times 2 = 42$ clusters). Cohorts are constructed with three education classifications, two race and across 4 regions for available data years in the CEX and GSS from 1982-1998. The education classifications are: less than high school, high school graduate, and some college. The two race classifications are white and non-white. Included in the regressions are: the probability of death next period (P_{it+1}), the percent of 3 member families in the cell (FAMSIZE3), the percent of 4 member families (FAMSIZE4), the percent of individuals who are married (MARRIED), the percent of individuals who are Catholic (CATH), the percent of individuals who are Jewish (JEWISH), the percent of individuals who are protestant (PROTESTANT), the percent of individuals who are conservative protestant (CONS. PROT.), and the log of average cell income (log(Y)). $\delta/R, \alpha$ and Ω are the estimated structural parameters in the underlying regression. Their standard errors are obtained using the delta method.

The results in Table 2 also demonstrate a few other noteworthy findings with respect to demographics. First, as shown in columns (IV) through (VI), the coefficients on the JEWISH and PROTESTANT variables are statistically significant and positive. Everything else equal, if the fraction of a cell reporting their religious denomination as Jewish increases by 10 percentage points, then this would indicate an approximate 0.6 percentage point higher tithing rate. A 10 percentage point increase in the percent Protestant would lead to a 0.1 percentage point increase in tithing. By contrast, the coefficient on CONS PROT is negative and statistically significant, indicating that a 10 percentage point increase in the percent reporting their denomination as conservative Protestant would lead to a 0.1 percentage point lower tithing rate, while the coefficient on CATHOLIC is not significantly different from zero. Second, family size variables do not seem to be important determinants of tithing. Lastly, income is a significant positive predictor of tithing, suggesting the possibility of liquidity constraints that are not directly incorporated into our theoretical analysis.

5.3 Estimates Using Household-Level Data

While the results presented in Table 2 use cohort-level data, we also investigate the flow tithing relationship (18) using the micro household data in the CEX. One benefit of the household-level data is that we have a tremendous increase in the number of observations – over 85 thousand as compared to 1,600 – although the cost is that we do not have religious affiliation at the household level. An additional benefit of using the household-level data is that in aggregating to the cohort-level data, we may have suppressed some useful variation in the data. Finally, using the household-level data we are also able to employ an instrumental variables approach to eliminate measurement error in an individuals perceived probability of death.

Table 3 estimates the specification in (18) using the household micro data. The estimates from the empirical specifications reported columns (I) through (VI) replicate the same type of

Table 3: Flow of Giving Micro-level Regression: 1982-1998

$$\tau_{it}/c_{it} = b_0 + b_1 \cdot P_{it+1} + b_2 \cdot P_{it}/(1 - P_{it}) + \zeta X_{ti} - +\varepsilon_{it}$$

$$b_0 = \alpha \left[1 - (\delta/R)\right]^{-1} \left[1 - (\delta/R\beta)\right], \quad b_1 = \Omega \left[1 - (\delta/R)\right]^{-1}, \quad b_2 = -(\alpha + \Omega)\left[1 - (\delta/R)\right](\delta/(R\beta))$$

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)
Constant	0.010***	0.007***	0.008***	0.007***	0.009***	0.001	−0.001	0.026***	0.023***
	[0.001]	[0.001]	[0.002]	[0.001]	[0.002]	[0.001]	[0.001]	[0.004]	[0.002]
P_{it+1}	1.780***	1.810***	2.040***	1.811***	1.953***	1.950***	5.623***	2.420***	6.532***
	[0.433]	[0.434]	[0.432]	[0.451]	[0.418]	[0.410]	[0.228]	[0.506]	[0.548]
$P_{it+1}/(1-P_{it+1})$	− 1.547***	− 1.574***	− 1.751***	− 1.575***	− 1.676***	− 1.669***	− 5.252***	− 2.029***	− 6.036***
	[0.398]	[0.399]	[0.393]	[0.413]	[0.379]	[0.372]	[0.224]	[0.456]	[0.536]
FAMSIZE3				0.000	−0.002**	−0.003**	− 0.001***	−0.006**	− 0.004***
				[0.001]	[0.001]	[0.001]	[0.000]	[0.002]	[0.001]
FAMSIZE4				0.000	−0.003*	−0.003*	− 0.001***	− 0.009***	− 0.006***
				[0.001]	[0.001]	[0.001]	[0.000]	[0.002]	[0.001]
EDUC1			− 0.011***		− 0.011***	− 0.010***	− 0.011***	− 0.010***	− 0.012***
			[0.001]		[0.001]	[0.001]	[0.001]	[0.003]	[0.002]
EDUC2			− 0.007***		− 0.006***	− 0.006***	− 0.007***	−0.005**	− 0.006***
			[0.001]		[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
EDUC3			− 0.005***		− 0.005***	− 0.004***	− 0.004***	−0.005*	− 0.005***
			[0.001]		[0.001]	[0.001]	[0.001]	[0.002]	[0.002]
EDUC4			−0.003		−0.003	−0.002	− 0.002***	−0.003	−0.003**
			[0.002]		[0.002]	[0.002]	[0.001]	[0.003]	[0.002]
MARRIED			0.007***		0.008***	0.007***	0.006***	0.005**	0.004***
			[0.000]		[0.000]	[0.000]	[0.000]	[0.001]	[0.001]
BLACK			0.003**		0.003**	0.003***	0.004***	0.005**	0.005***
			[0.001]		[0.001]	[0.001]	[0.000]	[0.002]	[0.001]
LOG(Y)						0.002**	0.002***	0.000	0.000
						[0.001]	[0.000]	[0.001]	[0.000]
$Y > 0$						−0.008*	− 0.008***	−0.005	−0.004
						[0.004]	[0.001]	[0.009]	[0.004]
δ/R	0.823***	0.830***	0.820***	0.830***	0.818***	0.836***	0.917***	0.781***	0.876***
	[0.017]	[0.015]	[0.015]	[0.015]	[0.015]	[0.012]	[0.003]	[0.021]	[0.006]
Ω	0.315***	0.307***	0.366***	0.307***	0.356***	0.319***	0.464***	0.530***	0.807***
	[0.047]	[0.047]	[0.049]	[0.049]	[0.048]	[0.046]	[0.016]	[0.062]	[0.039]
α	0.011***	0.008***	0.009***	0.008***	0.010***	0.001	−0.001	0.028***	0.027***
	[0.001]	[0.001]	[0.002]	[0.001]	[0.002]	[0.001]	[0.001]	[0.005]	[0.002]
OBS	85197	85197	85197	85197	85197	84155	84155	31476	31476
p-value							0.162		0.157

See Tables 2 for variable definitions. In addition, this table uses the following eduction variables: the percent of individuals with high school degree in the cohort (EDUC1), the percent of individuals with some college degree in the cohort (EDUC2), the percent of individuals with college degree in the cohort (EDUC3), and the percent of individuals with some graduate training in the cohort (EDUC4). With the exception of column (I), all regressions specifications contain estimated regional dummy variables. The p-value represents the significance of the over-identifying restriction in the instrumental variable regressions in columns (VII) and (IX). The coefficient estimates reported in columns (VIII) and (IX) are for the data sub-sample where religious contributions are strictly positive. The standard errors are clustered at the cohort level (7 cohorts). p-value is from a test of overidentifying restrictions for the instrumental variable models only.

specification as estimated with the cohort data. The main difference is that since the cohorts used in estimating the specifications in Table 2 are defined with respect to race, region and race, we now include these demographic factors as explanatory variables in the specification with household data presented in Table 3.[19] For instance, the specification reported in columns (II) includes region dummy variables (estimated coefficients not shown), while that in column (III) also includes education (EDUC1, EDUC2, EDUC3, and EDUC4), region, gender of the head of household, race (BLACK) and marital status (MARRIED).[20] The results in column (IV) include measures of family size (FAMSIZE3 and FAMSIZE4), while those in column (V) include the family size and demographic characteristics presented in columns (III) and (IV). Unfortunately, since the CEX does not have information on religious affiliation or religiosity, these variables cannot be included in these specifications. However, since these variables were constructed from the GSS by matching demographic characteristics common to the GSS and CEX, the impact from the omission of these religious affiliation variables should be less of an issue than if the demographic characteristics were not included in the regressions.[21]

The broad, consistent finding from the results in columns (I) through (VI) of Table 3 is that the estimated structural parameters using the micro data are very similar to those using cohort level data presented in Table 2. One thing to note, however, is that the estimates of Ω are slightly lower in the micro data as compared to the cohort level data. Overall, the estimate of α, Ω and δ/R are approximately 0.01, 0.3 and 0.83, respectively. Also, given the alternative specification of

[19]For the estimates using household-level data, we cluster the standard errors by cohort (7 cohorts) and do not include cohort fixed effects. However, estimating the model with cohort fixed effects and not clustering the standard errors at the cohort level does not affect our estimation results.

[20]For the household data analysis, we allow for 5 education types: the percent of individuals with high school degree in the cohort (EDUC1), the percent of individuals with some college degree in the cohort (EDUC2), the percent of individuals with college degree in the cohort (EDUC3), and the percent of individuals with some graduate training in the cohort (EDUC4). The omitted classification is the percentage of individuals with less than a high school degree. Note that unlike the cohort regressions, the demographic controls are dummy variables equal to one if the household head satisfies the specific criteria, and zero otherwise. Recall that with the cohort data, these demographic controls represented percentages of the cell that satisfied the specific criteria. Also, note that as in the cohort level regression results presented above, the death probabilities vary at the age, year, region and education levels. Finally, the regression results are not affected by the generous use of interaction terms among the demographic variables. We exclude these simply for parsimony.

[21]Indeed, as seen below, the estimated value of the main parameters of interest are generally the same across the cohort and household samples.

demographic controls in the household data as compared to the cohort data, some interesting new significant variation is captured in the estimates using household data. In particular, the results show that lower education and larger family size are related to lower tithing while both black households and married households tithe a large amount.

In columns (VI) through (IX) we also include the log of labor income plus a dummy variable for positive labor income in the specification. Interestingly, using the household data, higher income is associated with higher tithing. Like the similar results from the cohort level data, this result suggests that while our streamlined model of religious tithing may ignore possible issues with respect to liquidity constraints. Nevertheless, allowing for these effects, and contrasting the estimated coefficients in columns (V) and (VI), the estimated structural parameters are only slightly affected by the inclusion of these income measures.[22]

In the last three columns, we investigate two further issues. The first is that our probability of death measures the average probability of death given an individual's age and demographic group: however, an individual head of household may have private information about his or her own likelihood of death. Indeed, if a head of household's true probability of death is greater than that measured in our data, then they may be inclined to spend more on religious giving than our model would predict.[23] It is straightforward to show that using averaged data for the probability of death, in the presence of private information by an individual about their own probability of death, will bias our estimates of b_1 and b_2 in expression (18) towards zero. Hence, in column (VII) we estimate the model using instrumental variables. The instruments we pick for the two death probability measures are the head of household's age, age squared and a households health

[22]Note that the inclusion of these terms using the cohort data in Table 2 also did not change the estimated values of the structural parameters.

[23]Of course, with the cohort data, since it is averaged over households, we cannot exploit this potential property of the data.

care spending as a fraction of consumption spending. The results reported in the column indicate larger estimates in absolute value for the aforementioned reduced form coefficients and also larger estimates of Ω as well as δ/R. Note that the p-value reported at the bottom of the table indicates that the over-identifying restriction that the instruments are orthogonal to the error term is not violated at or below the 0.1 level. These somewhat larger estimates of the key coefficients are consistent with the interpretation that individual households have private information on their probability of death.

As a further issue, we also provide estimates for the data when we only use data for households that make a positive religious contribution. Of course, by removing the non-givers from the data we should see larger estimates for α and Ω. The estimates in columns (VIII) and (IX) are based on this sub-sample, and the two columns differ in that column (IX) is based on the instrumental variables procedure discussed above. To note, the estimates of α and Ω are higher: the estimate of α rises to 0.028, and that for Ω rises above 0.5 to as high as 0.8. Moreover, the estimated value of δ/R falls somewhat in the least squares estimates presented in column (VIII), though it returns to its previously estimated value of above 0.8 in the instrumental variables estimates presented in column (IX).

6 Remarks

Taken together, the estimates of the structural parameters of our model demonstrate the importance of both within lifetime and afterlife considerations in religious giving behavior. That is, households make religious contributions as if these contributions represent both within-life consumption and after-life investment.

To put our results in better context, it is useful to consider a few exercises to pin down the life-cycle forces driving religious giving. First, consider a steady state where the probability of death is constant, $\overline{P}$. From expression (17), the steady state tithing ratio becomes:

$$\overline{\tau/c} = [1-(\delta/R)]^{-1}\cdot\left[\alpha+\Omega\overline{P}\right]\cdot\left[1-\frac{\delta/R}{\beta(1-\overline{P})}\right] \tag{19}$$

In this scenario, if the probability of death is zero, the steady state tithing ratio will be $\overline{\tau/c} = \alpha\,[1-(\delta/R)]^{-1}\;[1-(\delta/R\beta)]$ which is approximately equal to α.[24] In other words, the long run level of religious giving, when the probability of death is constant over time, is driven by α (the within lifetime utility value of the stock of contributions). Moreover, continuing to use expression (19), whether the influence from religious giving in this life outweighs the influence of religious giving in the next life clearly depend on the extent to which α is greater than or equal to $\Omega\overline{P}$. Using the simplest estimate of $\hat{\alpha}=0.01$ and $\hat{\Omega}=0.3$ from column (1) in Table 3, and using the fact that the average level of $\overline{P}$ in the household data is 0.013 suggests that $\hat{\alpha}=0.01>\hat{\Omega}\overline{P}=0.003$.[25] Hence in the steady state, with a constant probability of death, the estimates suggest that factors in this life are dominant influences on religious giving.

Second, a permanent increase in the constant level of the probability of death can be interpreted by analyzing how the tithing ratio responds to a change in $\overline{P}$. As permanent levels of tithing are tied to α, it should come as little surprise, that the tithing ratio in this case is substantially insensitive to changes in the constant probability. The effect on the tithing ratio from an increase in the constant likelihood of death is equal to:

$$\frac{d\overline{\tau/c}}{d\overline{P}} = [1-(\delta/R)]^{-1}\left[\Omega\left\{1-\frac{\delta/R}{\beta(1-\overline{P})}\left(1+\frac{\overline{P}}{1-\overline{P}}\right)\right\}-\frac{\alpha\delta/R}{\beta(1-\overline{P})^2}\right] \tag{20}$$

It follows that even for sufficiently small values of $\overline{P}$, $d\overline{(\tau/c)}/d\overline{P}$ cannot be signed without knowing the magnitudes of α, Ω and δ/R. A special case is helpful, however. Note that if $\overline{P}=0$ and $\beta=1$, $d\overline{\tau/c}/d\overline{P}=\Omega-\alpha$. According to the estimates of these parameters presented above, $d\overline{\tau/c}/d\overline{P}>0$.

[24] If $\beta=1$, $\overline{\tau/c}$ is equal to α .

[25] This constant probability of death is associated with an expected life continuation of 76 years.

That is, the tithing ratio increases as the constant probability of death increases. More generally, using $\delta/R = 0.83$, $\alpha = 0.025$, $\Omega = 0.4$ and $\beta = 0.95$, doubling the constant probability of death from 0.013 to 0.026, leads to a rise in the tithing ratio from 0.0204 to 0.0214.[26] As one can see, in the parameter range that is consistent with the data, long run changes in the probability of death are not the driving forces behind tithing. Indeed, while one might suspect that rising life expectancy throughout the world could account for the decline in tithing rates from the biblically inspired one-tenth, according to our model such a conclusion would be unwarranted.

As a final exercise, consider what happens in response to a one-time, temporary, anticipated increase in the probability of death. That is, consider the case where $\epsilon_{it+1} \equiv P_{it+1} - P_{it} > 0$. This 'steepness' change in an individual's probability of death time horizon is unrelated to his or her baseline probability of death, which was analyzed above. From expression (17), the response of the tithing ratio today to a change in the probability of death next period will be:

$$\frac{d(\tau/c)_{it}}{d\epsilon_{it+1}} = [1 - (\delta/R)]^{-1}\,\Omega > 0 \qquad (21)$$

This effect is clearly positive, potentially quite large, and independent of the baseline probability of death. To get a handle on the magnitude of this effect, using $\delta/R = 0.83$, and $\Omega = 0.4$, we obtain that $d(\tau/c)_{it}/d\epsilon_{it+1} = 2.35$. Accordingly, a household whose probability of death increases (temporarily) by 0.1 would raise its tithing ratio by over .23, which is a very large response indeed. This demonstrates that, in practice, an increase in the risk of death is an influential determinant of the responsiveness of religious giving as compared to a change in the constant risk of death.

In sum, these exercises, calibrated to our empirical estimates, suggest two strong findings for understanding religious giving at the household level. First, after-life investment considerations (i.e. impending death) are an important determinant of the life-cycle profile of religious contributions.

[26]Given the constant probability of death, this is associated with a decline in life expectancy from 77 years to 38 years.

Second, within-life (i.e. religious consumption) factors pin down a household's average level of religious contributions over a lifetime.

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