

Bequest Motives and the Annuity Puzzle^{*}

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Abstract

Few retirees annuitize any wealth, a fact that has so far defied explanation within the standard framework of forward-looking, expected utility-maximizing agents. Bequest motives seem a natural explanation. Yet the prevailing view is that people with plausible bequest motives should annuitize *part* of their wealth, and thus that bequest motives cannot explain why most people do not annuitize *any* wealth. I show, however, that people with plausible bequest motives are likely to be better off not annuitizing any wealth at available rates. The gain from annuities depends crucially on how much people value the large bequests that arise incidentally from self-insuring lifespan risk. The evidence suggests that bequest motives play a central role in limiting the demand for annuities.

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1 Introduction

Decisions about how quickly to spend wealth during retirement are complicated by the substantial lifespan risk in old age. While roughly one-fifth of 65-year-olds in the US will die before they turn 75, another fifth will live to age 90 and beyond. People who spend too quickly risk outliving their assets and having a low standard of living in old age. People who spend too slowly forgo consumption unnecessarily. Life annuities, which convert a stock of wealth into a lifelong flow of income, insure people against the risk of outliving their assets. By pooling mortality risk, annuities transfer wealth from short-lived to long-lived annuitants. Annuities can thereby offer survivors a larger income stream than they could produce by holding in their personal accounts the assets in which the annuitized wealth is invested.

Although the considerable lifespan risk in old age suggests a valuable role for annuities in retirees' portfolios, voluntary annuitization is almost non-existent in most countries.¹ Among people at least 65 years old in the US, private annuities comprise just one percent of total wealth (Johnson, Burman and Kobes 2004). The lack of annuitization is especially surprising given the large welfare gains from annuities in life cycle models. Calibrated models suggest that typical 65-year-olds would be willing to pay one-fourth of their wealth for access to actuarially fair annuities, which exceeds the 10 to 15 percent loads (the excess of premiums over expected benefits) of available annuities (Mitchell, Poterba, Warshawsky and Brown 1999). The "annuity puzzle" literature has identified several extensions of the simple life cycle model that reduce annuity gains (see Brown (2007) for a review). But trying to understand the near absence of voluntary annuitization within the framework of forward-looking, expected utility-maximizing agents has proven so difficult as to prompt a search for explanations outside of the rational model (e.g. Brown, Kling, Mullainathan and Wrobel (2008)).²

¹See James and Song (2001) for information about Australia, Canada, Chile, Israel, Singapore, Switzerland, the UK, and the US. Variable annuities, which are the most popular type of annuity in most countries, are primarily a tax-deferred saving vehicle rather than longevity insurance. Less than one percent of variable annuity contracts in the US were converted to life annuities in 2003 (Beatrice and Drinkwater 2004).

²Perhaps the most successful way yet found to reduce the demand for annuities in life cycle models is to include

The perception that private annuity markets fail or that people fail to annuitize as much as they should is the primary justification for policies that mandate or encourage annuitization. In addition to the forced annuitization implicit in public pensions schemes, some countries, such as Germany and the UK, require people to at least partially annuitize the balances of their tax-advantaged savings accounts. An important step toward evaluating these policies is understanding why private annuity markets are so small in the first place.

In this paper, I investigate whether bequest motives—valuing the prospect of leaving wealth to family, friends, or other good causes—can explain why annuity markets are so small. I estimate the welfare gains from annuities in a calibrated model in which the only reason to prefer non-annuity wealth to annuity income is that non-annuity wealth is bequeathable. Even in this case, most people who wish to leave bequests would gain little from actuarially fair annuities and would be better off not annuitizing any wealth at available (actuarially unfair) rates. I next estimate the aggregate demand for annuities in a world in which everyone has one of three bequest motives from the saving literature. With any of these bequest motives, most people would be better off without available annuities.

The idea that bequest motives reduce optimal annuitization dates back at least to Yaari's (1965) seminal article and has considerable intuitive appeal: the single unavoidable cost of purchasing annuities is the foregone opportunity to bequeath that wealth. Despite this, the prevailing view in the literature is that while bequest motives may explain why people do not annuitize *all* of their wealth, they cannot explain why most people do not annuitize *any* of their wealth.³ The supposed desirability of partial annuitization is based on a result derived in a perfect markets setting. With actuarially fair annuities, people should annuitize enough wealth to cover their planned future consumption

equity markets but rule out equity-linked annuities (e.g. Michaelides, Lopes and Inkmann (2007) and Yogo (2009)). Forcing people to choose between the equity premium and annuities' "mortality premium" reduces the value of annuities, but it does not explain why equity-linked variable annuities are similarly unpopular. See Horneff, Maurer, Mitchell and Stamos (2009).

³An exception is Abel (2003), who cites the lack of annuitization as suggestive evidence of widespread bequest motives but does not investigate this quantitatively.

(Davidoff, Brown and Diamond 2005). According to this result, only people whose pre-existing annuity income (e.g. from Social Security and employer pensions) covers their desired consumption should not annuitize any wealth. That many people consume more than their pre-existing income but do not annuitize any wealth is therefore taken as evidence against the hypothesis that bequest motives explain the limited demand for annuities.

Yet as Davidoff et al. (2005) note, the prediction that people should annuitize all their future consumption strictly applies only if actuarially fair annuities are available. The applicability of this prediction to actual annuitization decisions depends on annuity prices being close enough to actuarially fair, which means roughly that annuity loads are small relative to the gain from fair annuities. The literature has shown that annuity loads are small relative to what selfish people gain from fair annuities (e.g. Mitchell et al. (1999)). I find, however, that annuity loads are not small relative to what people who wish to leave bequests gain from fair annuities. Although plausible bequest motives would not eliminate purchases of *actuarially fair* annuities, they can eliminate purchases of *available* annuities.

Plausible bequest motives can eliminate purchases of available annuities because they significantly reduce the cost of bearing lifespan risk. Without annuities, even people without bequest motives leave large bequests on average in an effort to smooth their consumption over time. Annuities allow people to trade these incidental bequests for greater consumption. This trade is a large free lunch for people without bequest motives and is the reason that selfish consumers' estimated annuity gains are so large and robust. Bequest motives, even those that have little effect on saving, can significantly reduce the gains from this trade. On the other hand, failing to annuitize future consumption means that bequests depend on realized lifespan. But unless people are very risk averse over bequests—much more than most altruists should be and more than is implied by the wealth elasticity of bequests—bequest insurance is not worth buying at even slightly actuarially unfair rates.

2 Theory

This section uses a simple model to explain the prevailing view that bequest motives should reduce but not eliminate annuitization and to explain why bequest motives may in fact eliminate annuitization.

2.1 Lifespan risk and annuities

Consider the wealth allocation decision of an individual who lives two periods with probability p and lives one period otherwise. In the first period, the individual chooses how much of his wealth, w , to consume, save, and annuitize, $c_1 + s + \pi = w$. Non-contingent saving, $s \geq 0$, earns a gross rate of return R regardless of whether the individual lives. Annuities, $\pi \geq 0$, earn a larger gross return than non-contingent saving if the individual lives, $R_a > R$, but return nothing if the individual dies. In old age, the individual receives income, y , in addition to his accumulated non-contingent saving and annuities. Bequests if the individual dies young and wealth in old age are

$$\begin{aligned} b_1 &= Rs &= R(w - c_1) - R\pi, \\ x_2 &= Rs + R_a\pi + y &= R(w - c_1) + (R_a - R)\pi + y. \end{aligned} \tag{1}$$

In old age, the individual splits his wealth between consumption and an immediate bequest, $c_2 + b_2 = x_2$. Bequests must be nonnegative, $b_1, b_2 \geq 0$.

Without annuities, the individual's choice of how much to bequeath should he die young and his choice of how much to consume and bequeath in old age are inseparable. Each unit of non-contingent saving buys R units of short-lifespan bequests and R units of wealth in old age. In saving for old age, short-lifespan bequests arise incidentally. In saving for short-lifespan bequests, wealth in old age arises incidentally. Annuities relax the constraint linking short-lifespan bequests and wealth in old age by allowing the individual to trade one for the other. Annuitizing an additional unit of saving reduces short-lifespan bequests by R and increases wealth in old age by

$(R_a - R)$. By paying benefits only if the annuitant lives, annuities convert “incidental” bequests into wealth in old age.

Suppose the individual maximizes expected utility,

$$EU = u(c_1) + \beta [pV(x_2) + (1 - p)v(b_1)],$$

where

$$V(x) = \max_{c \in [0, x]} \{u(c) + v(x - c)\}$$

is utility in old age as a function of wealth in old age, x . Utility from consumption and bequests, $u(\cdot)$ and $v(\cdot)$, are strictly increasing and strictly concave, and the marginal utility of consumption approaches infinity as consumption approaches zero. The optimal allocation in old age satisfies the first order condition $u'(c_2^*) \geq v'(b_2^*)$, which holds with equality if $b_2^* > 0$.

Net expected marginal utility of annuitizing an additional unit of saving is

$$\frac{\partial EU(c_1, \pi)}{\partial \pi} = \beta [p(R_a - R)V'(x_2) - (1 - p)Rv'(b_1)],$$

where I used (1), the budget constraints for short-lifespan bequests and wealth in old age, $b_1(c_1, \pi)$ and $x_2(c_1, \pi)$. This equation can be rewritten

$$\frac{\partial EU(c_1, \pi)}{\partial \pi} = \beta R [(1 - p - \lambda)V'(x_2) - (1 - p)v'(b_1)], \quad (2)$$

where $R_a = (1 - \lambda)\frac{R}{p}$ and $\lambda \geq 0$ is the *load*, the percentage by which premiums exceed expected discounted benefits. Actuarially fair annuities have $\lambda = 0$.⁴

⁴The actuarially fair rate of return on annuities equalizes premiums and expected discounted benefits, $\pi = \frac{pR_a\pi}{R}$, so $R_a = \frac{R}{p}$.

2.2 Rejection of bequest motives

If actuarially fair annuities are available ($\lambda = 0$), the expected marginal utility of annuitizing savings is proportional to $(V'(x_2) - v'(b_1))$. The individual annuitizes his savings up until the marginal utility of short-lifespan bequests equals the marginal utility of wealth in old age or until he annuitizes all of his savings, whichever comes first: $V'(x_2^*) \geq v'(b_1^*)$, which holds with equality if $b_1^* > 0$.⁵ The individual annuitizes what he wishes to consume above endowed income and bequeaths the rest, $c^* = R_a \pi^* + y$ and $b_1^* = b_2^* = R(w - c_1^* - \pi^*)$. Thus, *with fair annuities, people set aside what they wish to bequeath and annuitize all future consumption* (Davidoff et al. 2005).^{6,7} At the optimum, bequests are insured against lifespan risk and consumption and bequests are equally valuable at the margin if the individual leaves a bequest.

This result is the basis for the view that bequest motives do not explain why so few people annuitize any wealth. With fair annuities, the only people who should not annuitize any wealth are those whose pre-existing income covers their desired future consumption or, what is equivalent in this model, those who wish to leave all of their non-annuity wealth as a bequest. It appears, however, that many people who do not annuitize any wealth consume more than their pre-existing income. Most retirees expect to and do leave bequests worth less than their stock of wealth at retirement (Hurd and Smith 2002), and many more people report saving for retirement than report saving to leave bequests (Dynan, Skinner and Zeldes 2002).

With actuarially unfair annuities ($\lambda > 0$), people who wish to leave bequests no longer fully

⁵I assume throughout that the individual wishes to consume more than his endowed income in old age. This means that, without annuities, the marginal utility of wealth in old age exceeds the marginal utility of short-lifespan bequests: $V'(x_2) = u'(c_2) \geq v'(b_2) > v'(b_1)$. The last inequality follows because long-lifespan bequests are smaller than short-lifespan bequests when consumption exceeds income in old age, $c_2 > y \implies b_2 = R(w - c_1) - (c_2 - y) < R(w - c_1) = b_1$. People who wish to consume more than their endowed income in old age would annuitize some wealth at actuarially fair rates. They therefore would not buy actuarially fair life insurance, which is equivalent to selling actuarially fair annuities, ($\pi^* < 0$). That most people are not over-annuitized by public and employer pensions is consistent with Brown (2001a), who finds that life insurance ownership in old age appears to be driven more by tax incentives and past decisions than by a desire to increase bequests at the expense of consumption.

⁶As Davidoff et al. (2005) note, this result is implicit in Yaari (1965).

⁷This simple model ignores many factors that could reduce optimal annuitization, such as uninsured medical spending risk. But Davidoff et al. (2005) show that substantial annuitization remains optimal under fairly general conditions.

annuitize planned future consumption: $V'(x_2^*) > v'(b_1^*)$, which implies $b_2^* < b_1^*$ and $c_2^* > R_a \pi^* + y$ if $b_1^* > 0$ (Davidoff et al. 2005). Large enough loads can eliminate annuity purchases even by people who wish to consume more than their endowed income in old age. For large enough λ , annuitizing wealth may reduce expected utility,

$$\frac{\partial EU(c_1^*, \pi = 0)}{\partial \pi} = \beta R [(1 - p - \lambda)V'(R(w - c_1^*)) - (1 - p)v'(R(w - c_1^*))] < 0,$$

even among people who would benefit from fair annuities, $V'(R(w - c_1^*)) > v'(R(w - c_1^*))$. Yet one would expect purchases of annuities whose prices are close to actuarially fair to approximate purchases of fair annuities. Empirically, annuity *prices* appear reasonably close to actuarially fair: annuity loads are a smaller percentage of premiums than loads in several insurance markets with widespread participation and are smaller than the welfare gains from actuarially fair annuities in simulation models.⁸ But annuity *purchases* appear to be much smaller than one would expect with actuarially fair annuities.

There are at least two explanations for the discrepancy between observed behavior and the prediction of the actuarially fair annuities model. One explanation is that the lack of annuitization is due to something missing from the simple model. This interpretation has prompted investigations of several possibilities. An alternative explanation, which I test in this paper, is that the loads on available annuities are not small enough for the perfect markets model to provide reliable predictions of annuitization. Although annuity loads are small relative to what people without bequest motives gain from actuarially fair annuities, they may be large relative to what people with bequest motives gain from fair annuities.

⁸Loads estimated in the US private annuity market average 10 to 15 percent. The willingness to pay for actuarially fair annuities in the baseline model is about 25 percent of non-annuity wealth (Mitchell et al. 1999).

2.3 Bequest motives and the value of annuities

For people who wish to consume more than their pre-existing income, annuitizing future consumption increases consumption at the expense of bequests, smooths consumption, and insures bequests. Consider how bequest motives affect the gain from each component in turn.

The gain from increasing consumption at the expense of bequests.— Annuitizing savings (given c_1) reduces short-lifespan bequests and increases wealth in old age, some of which is spent on consumption. For people without bequest motives, increasing consumption at the expense of bequests is a free lunch that significantly increases welfare in calibrated models. The benefits are so large because, without annuities, people who wish to smooth their consumption over time leave large bequests whether they value them or not. Kotlikoff and Spivak (1981) estimate that 55-year-olds without bequest motives consume only about three-fourths of their wealth on average.⁹ Fully annuitizing their wealth using an annuity with a ten percent load would allow them to consume 90 percent of their wealth on average, 15 percent more than they consume without annuities. Of course, this increase in consumption comes at the expense of bequests. By fully annuitizing, people leave no bequest instead of leaving bequests worth one-fourth of their wealth on average. Whereas someone without a bequest motive would be willing to pay roughly 17 percent of his wealth for this opportunity to trade his bequests for greater consumption, someone who valued bequests at 50 cents on the dollar would be willing to pay roughly 4.5 percent of his wealth, about one-fourth as much.¹⁰

The gain from smoothing consumption.— By eliminating the risk of leaving larger bequests than one wishes, annuities also have a consumption smoothing benefit. Without annuities, the first

⁹Specifically, a 55-year-old man with no annuitized wealth and constant relative risk aversion preferences with coefficient of risk aversion $\sigma = .75$ consumes about three-fourths of his wealth on average. An otherwise identical individual with a stronger preference for smooth consumption, $\sigma = 1.75$, consumes only about two-thirds of his wealth on average.

¹⁰Someone without a bequest motive would be willing to pay wtp , where $.90(w - wtp) = .75w$. This implies $wtp \approx .17w$. Someone who values bequests at 50 cents on the dollar would be willing to pay $.17 - 0.50 \times .25 = .045$.

order condition for consumption in the first period is

$$u'(c_1^*) = \beta R [(1 - p)v'(b_1^*) + pV'(x_2^*)].^{11}$$

Wealth in old age is more valuable at the margin than short-lifespan bequests, $V'(x_2^*) \geq v'(b_2^*) > v'(b_1^*)$, because the individual spends some of his short-lifespan bequest on consumption in old age. In deciding how much to consume in the first period, the individual trades off the cost of consuming “too” aggressively ($u'(c_1) < \beta R u'(c_2)$) against the cost of leaving “excess” bequests ($u'(c_1) > v'(b_1)$). With log utility and the discount rate equal to the interest rate, people without bequest motives choose $c_2^* = \max\{pc_1^*, y\}$. They consume as little as half as much at age 85 as at age 65 because 65-year-olds have a fifty percent chance of surviving to age 85.¹² Bequest motives increase the return to saving and thereby encourage people to choose consumption paths that are closer to the optimal consumption path with perfect annuity markets. By consuming some of their “intended” bequests in long-lifespan states, people with bequest motives partially insure their consumption against lifespan risk.

The gain from insuring bequests.—Whereas people who wish to leave small bequests use annuities mostly to increase consumption at the expense of bequests, people who wish to leave larger bequests use annuities mostly to insure their bequests. Although people who are risk averse over bequests would benefit from insuring their bequests at actuarially fair rates, bequest insurance may not be sufficiently valuable to justify paying available annuity loads for it. Most altruists and their beneficiaries, for example, should not be very risk averse over bequests because bequests are usually small relative to beneficiaries’ total wealth.

In deciding how much wealth to annuitize at actuarially unfair rates, people trade off the ben-

¹¹This first order condition holds with equality because of the assumption that the individual wishes to consume more than his income in old age, which implies $c_1^* < w$.

¹²According to US Social Security Administration forecasts, the average 65-year-old male born in 1950 has about a fifty percent chance of living to at least age 83 (Bell and Miller 2005). The average female has about a fifty percent chance of living to at least age 88.

efits of a better distribution of wealth between consumption and bequests, a better distribution of consumption over time, and less risky bequests against the cost of reducing total consumption and bequests by the annuity loads.¹³ The next section tests whether the smaller gains from annuities that people with bequest motives would enjoy are large enough to warrant paying available loads.¹⁴

3 Simulations

3.1 Baseline model and parameterization

This section presents the life cycle model I use to estimate the effect of bequest motives on the demand for and welfare gain from annuities. Other than bequest motives, the model is the standard model considered in the annuity literature. It excludes all other factors that reduce the gains from annuities such as family risk sharing and uninsured medical spending risk.¹⁵ A 65-year-old chooses a consumption path to maximize expected utility,

$$EU = \sum_{t=65}^T \beta^{t-65} S_t u(c_t) + \sum_{t=66}^{T+1} \beta^{t-65} p_t v(b_t),$$

¹³Buying annuities with loads ($\lambda > 0$) increases expected wealth in old age by less than it decreases expected short-lifespan bequests: $E(b_1 + x_2) = (1 - p)b_1 + px_2 = R(w - c_1) + py - R\lambda\pi$ is decreasing in π .

¹⁴Most estimates of the demand for and value of annuities are based on models without bequest motives. The exceptions typically include several factors that reduce annuity demand in addition to bequest motives (e.g. Michaelides et al. (2007) and Ameriks, Caplin, Laufer and Van Nieuwerburgh (2008)), which makes it difficult to determine how bequest motives affect the value of insuring lifespan risk. Two exceptions that focus especially on bequest motives are Friedman and Warshawsky (1990) and Vidal-Melia and Lejarraga-Garcia (2006). They show that strong enough bequest motives can eliminate purchases of annuities with high enough loads. But both papers use bequest motives whose strength is difficult to interpret and whose homothetic form is inappropriate for altruists and inconsistent with some patterns in the data.

¹⁵The model also excludes taxes. Excluding estate and gift taxes is without much loss for understanding the choices of most people in the US, as few people have enough wealth to be subject to the estate tax. In 2008, for example, only estates worth more than \$2 million were taxed. While the size of estates that are exempt from taxes has varied, estate taxes have typically been levied on between one and two percent of all estates (Chamberlain, Prante and Fleenor 2006). The tax treatment of capital gains, however, likely has a bigger effect on tradeoffs involving bequests. Currently in the US, the cost basis of inherited assets is “stepped up” to market value at the time of the decedent’s death. Capital gains realized on the assets during the decedent’s life are not taxed, which subsidizes bequests.

subject to the constraint that bequests must be nonnegative,

$$b_t = (1+r)^{t-65}(N - \Pi) - \sum_{s=1}^{t-65} (1+r)^s (c_{t-s} - y) \geq 0, \quad \forall t \in \{66, 67, \dots, T+1\}.$$

T is the maximum achievable age, S_t is the probability of living to at least age t , and $p_t = S_t - S_{t-1}$ is the probability of dying between age $t-1$ and age t . The individual discounts future utility from consumption and bequests, $u(c)$ and $v(b)$, with the same discount factor, β . Assets earn a certain, real after-tax return, r . The individual may use some of his initial non-annuity wealth, N , to purchase a single-premium immediate annuity. Total income from public and private pensions and from private annuities is constant in real terms and equal to y . In exchange for a single premium paid at age 65, Π , annuities provide the individual with a constant real income stream beginning immediately and lasting until death. The premium for an annuity paying a constant real income stream of a for life is

$$\Pi(a, \lambda) = \sum_{t=65}^T \frac{S_t a}{(1+r)^{t-65}} / (1-\lambda),$$

where λ is the load. Actuarially fair annuities have zero load, $\lambda = 0$. Annuities with a five percent load ($\lambda = .05$) pay on average 95 cents of income per dollar of premiums.

The discount rate and the interest rate are three percent per year, $\beta = \frac{1}{1+r} = \frac{1}{1.03}$. The coefficient of relative risk aversion, σ , is two. Mortality probabilities come from the 2003 US Social Security Administration male life table, adjusted so that the maximum possible age is 110 years, $T = 110$. Setting a maximum age allows me to solve the model via backward induction.

Utility from consumption is constant elasticity, $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$. Utility from bequests takes the following form

$$v(b) = \theta_1 \frac{(\theta_2 + b)^{1-\theta_3}}{1-\theta_3}.$$

This form incorporates as special cases most of the bequest motives used in life cycle models. $\theta_1 \geq 0$ determines the strength of the bequest motive. $\theta_2 \geq 0$ and $\theta_3 \geq 0$ determine the wealth

elasticity of bequests and risk aversion over bequests.¹⁶ Bequests are a luxury good if $\theta_3 < \sigma$ or if $\theta_3 = \sigma$ and $\theta_2 > 0$. Empirically, bequests are a luxury good: rich people leave a larger fraction of their wealth to their heirs than the poor.¹⁷ I present results for four combinations of θ_2 and θ_3 .

Linear bequest motives: $v(b) = \theta_1 b$ ($\theta_3 = 0$).— With linear (constant marginal utility) bequest motives, preferences over consumption and bequests are quasilinear and bequests are an extreme luxury good. With actuarially fair annuities, people with linear bequest motives leave bequests only if they have more than enough wealth to purchase their desired consumption stream. They leave any wealth in excess of this amount as bequests. People are risk neutral over bequests; they care only about their expected bequest. Linear bequest motives are sometimes used to approximate altruistic bequest motives (e.g. Hurd (1987)), which arise from concern about the welfare of one's heirs, and are sometimes used to describe “joy-of-giving” bequest motives (e.g. Kopczuk and Lupton (2007)), which arise from enjoying giving for its own sake. Most altruists should have approximately linear bequest motives because bequests are typically small relative to recipients' total (human and non-human) wealth. Bequest-sized windfalls thus have little effect on recipients' marginal utility of wealth and so on the altruist's marginal utility of bequests. Linear bequest motives are a particularly good approximation for altruists who have multiple heirs, whose heirs have bequest motives, or who give to large organizations. A linear bequest motive matches almost perfectly Hurd and Smith's (2002) estimates of the increase in anticipated bequests during the 1990s boom in asset markets.¹⁸

Threshold bequest motives: $v(b) = \theta_1 \frac{(\theta_2 + b)^{1-\sigma}}{1-\sigma}$ ($\theta_2 > 0$, $\theta_3 = \sigma$).— Threshold bequest motives

¹⁶As Carroll (2000) emphasizes, the wealth elasticity of bequests and risk aversion over bequests are closely related.

¹⁷Hurd and Smith (2002) estimate a wealth elasticity of anticipated bequests of 1.3, which is similar to estimates based on realized bequests (e.g. Auten and Joulfaian (1996)). Among single Americans who were at least 70 years old in 1993 and died before 1995, the 30th percentile of the bequest distribution was just \$2 thousand, the median was \$42 thousand, and the mean was \$82 thousand (Hurd and Smith 2002).

¹⁸Hurd and Smith (2002) estimate that, between 1993 and 1995, average anticipated bequests (based on how likely people say they are to leave bequests of different sizes) by households age 70 and over increased from about \$70 thousand to about \$123 thousand. Average wealth increased from about \$188 thousand to about \$290 thousand over the same period. In my model, the same linear bequest motive that matches expected bequests in 1993 given average wealth in 1993 matches expected bequests in 1995 given average wealth in 1995 almost exactly.

are similar to linear bequest motives in that bequests are a luxury good. But they are unlike linear bequest motives in that the marginal utility of bequests decreases in the size of the bequest—people are risk averse over bequests.¹⁹ θ_2 determines the threshold wealth level below which an individual with access to actuarially fair annuities leaves no bequest. Richer individuals divide their wealth above the threshold between consumption and bequests in a fixed proportion. The larger is θ_2 , the higher is the threshold, and so the greater the extent to which bequests are a luxury good.

An intuitive way to parameterize Threshold bequest motives is to imagine an altruist who has a single, selfish heir with a T_h -year planning horizon, $v(b) = a \sum_{i=1}^{T_h} \beta^{i-1} u(c_i^h(b))$. If the heir consumes her income, y_h , plus the annuity value of any bequest received and has the same constant elasticity preferences for consumption as the altruist, then

$$v(b) = a \left(\sum_{i=1}^{T_h} \beta^{i-1} \right) \frac{\left(y_h + \frac{b}{\sum_{i=1}^{T_h} (1+r)^{-(i-1)}} \right)^{1-\sigma}}{1-\sigma} \propto \frac{\left(\sum_{i=1}^{T_h} \frac{y_h}{(1+r)^{i-1}} + b \right)^{1-\sigma}}{1-\sigma}.$$

In this case, θ_2 is the discounted value of the heir's income, $\theta_2 = \sum_{i=1}^{T_h} \frac{y_h}{(1+r)^{i-1}}$. This leaves two parameters to be specified: y_h and T_h . I assume that the heir's income is equal to what the individual's income would be if he fully annuitized his wealth at the actuarially fair rate, $y_h = y_{full}$. I report results for $T_h = 40$ and $T_h = 10$ ("Threshold 40" and "Threshold 10"). Threshold bequest motives may represent joy-of-giving bequest motives or altruistic bequest motives for altruists who are unusually risk averse over their bequests. Most altruists' bequest motives should be between the Linear and Threshold 40 cases.

Homothetic bequest motives: $v(b) = \theta_1 \frac{b^{1-\sigma}}{1-\sigma}$ ($\theta_2 = 0$, $\theta_3 = \sigma$).—Homothetic preferences over consumption and bequests are inconsistent with the evidence that bequests are a luxury good, but they are occasionally used in simulation models. I include them to test the robustness of the results to unusually high risk aversion over bequests.

¹⁹De Nardi (2004) uses a bequest motive of this form (with a slightly different parameterization) to study the distribution of wealth in the US and Sweden.

3.2 Results

3.2.1 Should people who wish to leave bequests buy available annuities?

In this section, I measure the welfare gain from annuities as a function of how much wealth the individual wishes to leave to his heirs. The gain from annuities is the fraction of the individual's non-annuity wealth that he would be willing to pay for access to the annuities, $\frac{WTP}{N}$.²⁰ The demand for bequests is the fraction of the individual's non-annuity wealth that he would bequeath had he access to actuarially fair annuities, $\frac{b^*}{N} \in [0, 1]$; he would annuitize the remainder, $\frac{\Pi^*}{N} = (1 - \frac{b^*}{N})$. The bequest motive at the $\frac{b^*}{N} = 0$ position is the strongest bequest motive consistent with leaving no bequest, which for linear and threshold bequest motives is not the same as having no bequest motive.²¹

I present results for individuals with one-third, two-thirds, and three-fourths of their wealth already annuitized by public and employer pensions. These are roughly the average shares among US households headed by 65-year-olds in the top decile of the wealth distribution, around the median, and around the third decile, respectively (Dushi and Webb 2004). The results, which measure the gain from annuities as a function of $\frac{b^*}{N}$, are invariant to the overall level of wealth given the fraction of wealth already annuitized.

Figure 1 shows how bequest motives affect the welfare gain from annuities with different loads. People who wish to leave bequests gain less—often much less—from annuities. The first panel shows that while people in the middle of the wealth distribution who have no bequest motive are willing to pay 21.8 percent of their non-annuity wealth for access to actuarially fair annuities, most altruists (whose preferences are between Linear and Threshold 40) who would bequeath one-fourth of their wealth had they access to fair annuities are willing to pay about two percent. Even people

²⁰An individual with initial non-annuity wealth $(N - WTP)$ and with access to annuity markets is equally well off as an otherwise identical individual with initial non-annuity wealth N and without access to annuities. Willingness to pay for access to annuities is always nonnegative since the individual can always choose not to annuitize any wealth.

²¹With fair annuities, the individual fully annuitizes if and only if $u'(c_{full}) \geq v'(0)$. The linear and threshold bequest motives at the $\frac{b^*}{N} = 0$ position are such that $u'(c_{full}) = v'(0)$.

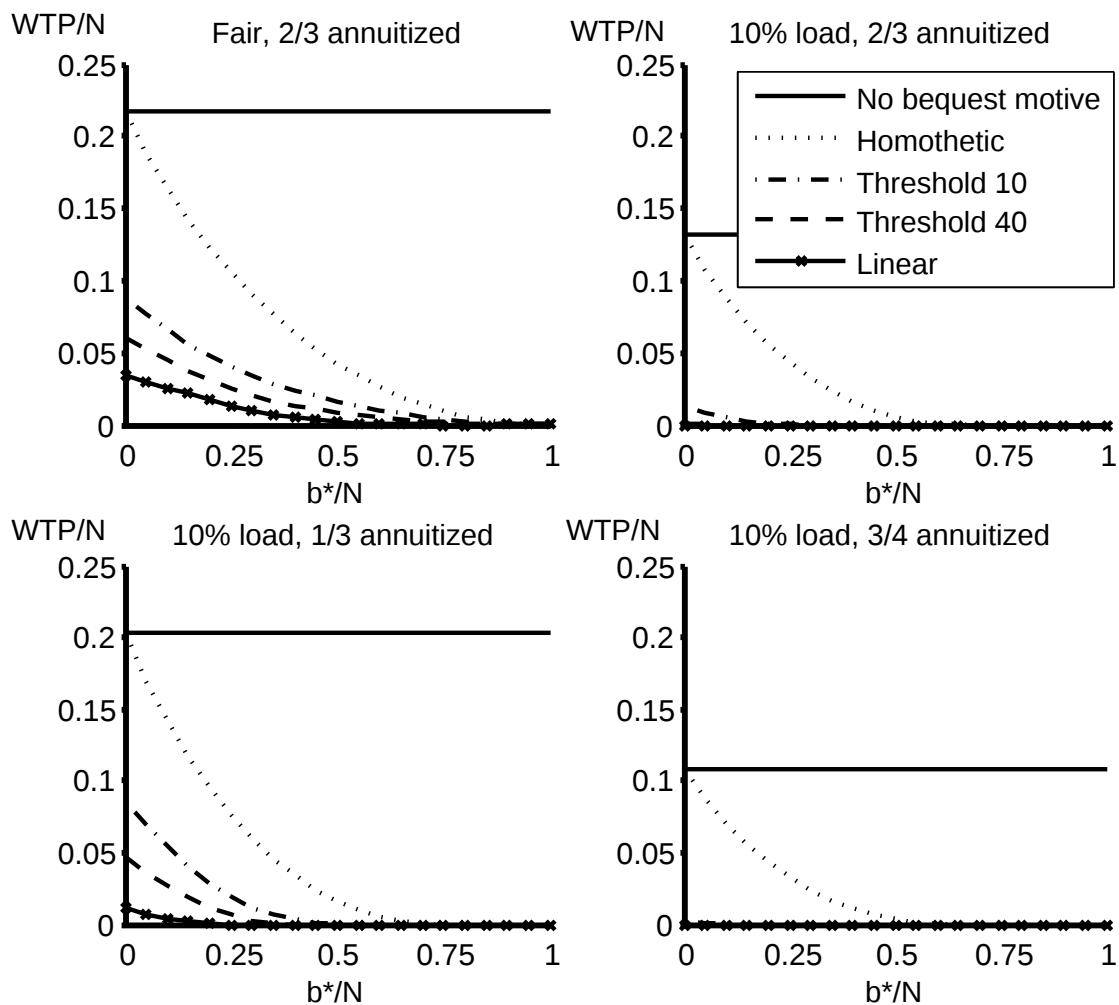


Figure 1: Welfare gains from annuities as a function of the type and strength of bequest motives. The y-axes measure the gain from annuities as the fraction of the individual's non-annuity wealth that he would be willing to pay for access to the annuities. The x-axes measure the strength of bequest motives as the fraction of the individual's non-annuity wealth that he would bequeath had he access to actuarially fair annuities. The first panel corresponds to actuarially fair annuities and the rest to annuities with ten percent loads. The results in the top panels are for individuals with two-thirds of their wealth already annuitized, which is typical of 65-year-olds in the middle of the wealth distribution. The results in the Southwest panel are for individuals with one-third of their wealth already annuitized, which is the average share among 65-year-olds in the top wealth decile. The results in the last panel are for individuals with three-fourths of their wealth already annuitized, which is roughly the average share among 65-year-olds in the second and third deciles of the wealth distribution.

who are unusually risk averse over bequests or who wish to leave only small bequests may gain much less from annuities than people without bequest motives. An altruist who wishes to leave just five percent of his wealth to a single, selfish heir with a ten-year planning horizon (Threshold 10) is willing to pay 7.7 percent of his non-annuity wealth for access to fair annuities. These results show that the key factor driving the large, robust gains from annuities typically estimated in the literature is the assumption that people place zero value on the prospect of leaving wealth to their heirs. For people who wish to leave bequests, non-annuity wealth and actuarially equivalent income streams are fairly close substitutes.

The results in the second, third, and fourth panels of Figure 1 reject the prevailing view that people who wish to leave bequests should partially annuitize their wealth. Even people who would annuitize most of their wealth had they access to actuarially fair annuities may be better off not annuitizing any wealth in the US private annuity market, where loads average 10 to 15 percent of premiums (Brown 2007). Altruists in the middle or bottom of the wealth distribution (the Northeast and Southeast panels) who would leave *any* bequest had they access to fair annuities ($\frac{b^*}{N} \geq 0$) are likely to be better off not annuitizing any wealth at ten percent loads. Altruists at the very top of the wealth distribution (the Southwest panel) who would bequeath one-fourth of their non-annuity wealth (and annuitize three-fourths) had they access to fair annuities ($\frac{b^*}{N} = \frac{1}{4}$) are likely better off not annuitizing any wealth at ten percent loads. By contrast, only people who wish to leave their entire stock of non-annuity wealth or more as a bequest ($\frac{b^*}{N} \geq 1$) would not annuitize any wealth at actuarially fair rates. Bequest motives much weaker than those required to eliminate purchases of fair annuities can eliminate purchases of annuities with ten percent loads. People who wish to leave bequests and are not especially risk averse over bequests are likely to be better off without available annuities.

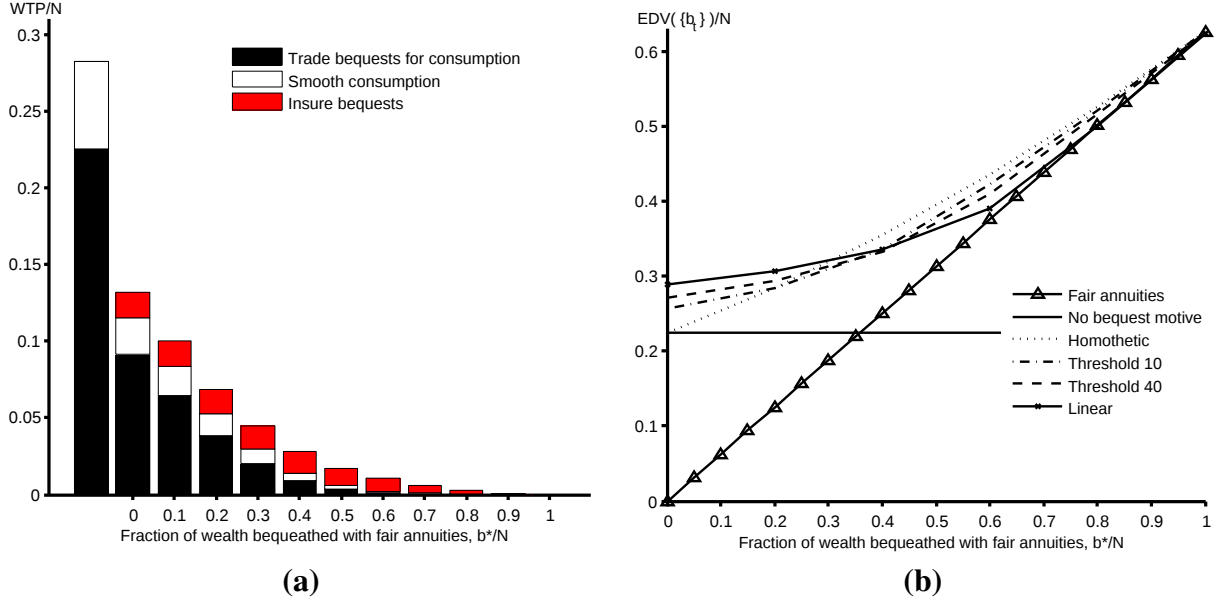


Figure 2: Panel (a): Components of the gain from actuarially fair annuities for an individual without a bequest motive (first bar) and for an individual with Threshold 40 bequest motives (roughly the bequest motives of an altruist who has a single, selfish heir with a 40-year planning horizon). Panel (b): Expected discounted bequests as a fraction of initial non-annuity wealth. In both panels, one-third of wealth is already annuitized.

3.2.2 Why do bequest motives reduce annuity gains so much?

To understand why bequest motives can have such a large effect on the value of annuities, decompose the gains from annuities into three parts: from trading bequests for consumption, from smoothing consumption, and from insuring bequests. Panel (a) of Figure 2 shows the size of each of these gains for people who have one-third of their wealth already annuitized and who have no bequest motive (the first bar) or have Threshold 40 bequest motives.²² By far the largest component of the gain from annuities for people with low demand for bequests is the gain from trading

²²The gain from smoothing consumption is the excess of the expected discounted value of the uninsured consumption path over the expected discounted value of the welfare-equivalent flat consumption path. The gain from bequest insurance is the excess of the expected discounted value of uninsured bequests and the discounted value of the welfare-equivalent certain bequest (and people without bequest motives do not value bequest insurance). The gain from trading bequests for consumption is the residual gain from annuities not accounted for by consumption smoothing or bequest insurance. Kotlikoff and Spivak (1981) decompose annuity gains for people without bequest motives. They call the gain from smoothing consumption “the substitution effect” and the gain from trading bequests for consumption “the income effect”.

bequests for consumption, which accounts for 80 percent of the gain from annuities for people without bequest motives. In addition to gaining less from trading bequests for consumption, people with bequest motives also gain less from annuities' consumption smoothing role because, without annuities, bequests partially insure consumption. Finally, Panel (a) shows that even people with Threshold 40 bequest motives—who are more risk averse over bequests than most altruists should be—gain little from bequest insurance. Only in rare cases would altruists (and their heirs) be sufficiently risk averse over bequests to justify using currently available annuities to insure their bequests.

Panel (b) of Figure 2 shows expected discounted bequests by people with and without annuities as a function of bequest motives.²³ In accordance with the results in Panel (a), Panel (b) shows that much of what annuities do for people who wish to leave little or nothing to their heirs is allow them to convert incidental bequests into greater consumption. Without annuities, people who die young leave large bequests whether they value them or not. In the simulation, even people without bequest motives leave bequests worth 22.6 percent of their wealth on average (hence the 22.6 percent gain from trading bequests for consumption in Panel (a)). Even people who would set aside one-third of their wealth for bequests had they access to actuarially fair annuities ($\frac{b^*}{N} = \frac{1}{3}$) leave bequests worth about ten percent more of their non-annuity wealth on average if they do not buy annuities than if they buy actuarially fair annuities. The value that people place on the bequests that arise incidentally from financing future consumption with non-annuity wealth is the primary determinant of the gain from annuities. People who do not wish to trade most of their (expected) bequests for greater consumption are unlikely to benefit from buying available annuities.

Because average bequests by people with low demand for bequests are much larger without annuities than with annuities, the potential heirs of such people would usually prefer that their benefactors did not buy annuities. Potential heirs may be able to persuade their benefactors not to

²³Expected discounted bequests with fair annuities are smaller than the fraction of wealth set aside for bequests because the individual's preferences are over *real* bequests rather than the *discounted value* of bequests. Defining preferences over the discounted value of bequests has little effect on the results.

annuitize, perhaps in exchange for a promise of support in old age.^{24,25}

Panel (b) of Figure 2 also shows how an alternative measure of the strength of bequest motives (expected bequests by people without annuities) relates to the primary measure, the amount of wealth people would set aside for bequests had they access to actuarially fair annuities. This alternative measure and the two in the Appendix show that bequest motives that have relatively minor effects on saving can eliminate purchases of available annuities. Linear bequest motives that increase expected discounted bequests by people without annuities from 22.6 to 31.3 percent of their non-annuity wealth eliminate purchases of annuities with ten percent loads. The figures in the Appendix show that bequest motives capable of eliminating annuitization may have little effect on the optimal consumption path or on the age at which people exhaust their wealth.

3.2.3 Can bequest motives explain why so few people buy annuities?

Considerable evidence suggests that bequest motives are widespread and have important effects on the economy. Inter-household transfers are common and large (Gale and Scholz 1994). Compared to optimal behavior in selfish life cycle models, most households accumulate too much wealth before retirement (Scholz, Seshadri and Khitatrakun 2006)²⁶ and decumulate wealth too slowly after retirement (Palumbo 1999).²⁷ In fact, except for emergencies, many retirees *actively save* (spend

²⁴Kotlikoff and Spivak (1981) show that risk sharing arrangements of this type between (selfish) spouses or between parents and children can insure lifespan risk remarkably effectively. Bequest motives likely facilitate such arrangements by reducing transactions costs. Whereas selfish people must secure an up-front payment or a promise of future support from their heirs, people with sufficiently high demand for bequests can support themselves by spending their “intended” bequests before they die.

²⁵The standard case of gift externalities (givers do not fully appropriate the benefit of their gifts) precludes gainful bargaining between givers and recipients because recipients cannot pay the givers to give larger gifts; such payments would undo some of the giving (Kaplowsky 1995). Lifespan risk, on the other hand, leads very naturally to state-contingent preferences, which increases the scope for gainful trades of contingent claims. The heirs to the individual’s estate can encourage the individual not to annuitize (and so leave larger bequests if he dies young) by promising to support the individual in old age.

²⁶Some economists disagree that people are saving enough for retirement. See Skinner (2007).

²⁷One manifestation of slow wealth decumulation is that people rarely spend their home equity, especially absent shocks such as a spouse’s death or nursing home admission (Venti and Wise 2004). Davidoff (2009) shows that housing wealth can substitute for annuities and long-term care insurance if people sell their house only if they live a long time or require long-term care. As he notes, this raises the question of why people do not take out reverse mortgages. My results suggest that just as people need not wish to bequeath all of their non-annuity wealth to be better off not buying

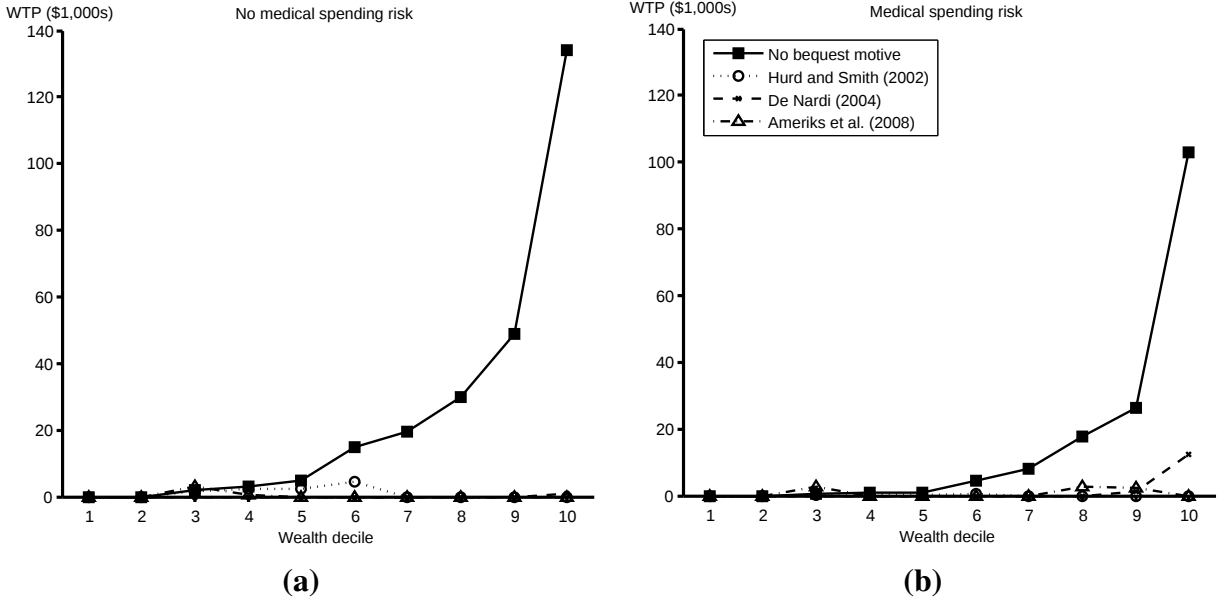


Figure 3: Welfare gains from annuities with ten percent loads for 65-year-olds at various points of the wealth distribution as a function of the bequest motive. The y-axes measure the gain from annuities as the willingness to pay for access to the annuities in thousands of dollars. The x-axes show the wealth deciles. Panel (a) uses the baseline model with no medical spending risk. Panel (b) includes medical spending risk.

less than their after-tax income) during retirement (Dynan, Skinner and Zeldes (2004)). De Nardi (2004) shows that bequest motives help make model-predicted saving behavior and wealth distributions more consistent with data from the US and Sweden. Dynan et al. (2004) conclude that one reason the rich save a larger fraction of their permanent income than the poor is their desire to leave bequests. Ameriks, Caplin, Laufer and Van Nieuwerburgh (2007) conclude from consumption choices and responses to a survey designed to separately identify bequest motives and precautionary motives that “strong bequest motives are too prevalent to be ignored”.

Figure 3 shows the gains from annuities with ten percent loads (a relatively small load in the US private market) for 65-year-olds at various points of the wealth distribution as a function of their bequest motives. Panel (a) shows results from the baseline model without medical spending risk annuities, they need not wish to bequeath all of their home equity to be better off without reverse mortgages. Only people who wish to consume almost all of their non-annuity wealth (including housing) in typical states of the world are likely to benefit from annuities and reverse mortgages at current prices.

and Panel (b) shows results from a model that includes Brown and Finkelstein's (2008) parameterization of medical spending risk. (The appendix contains details about the model and procedure.) The estimates of willingness to pay are by individuals with the decile averages of total wealth and the share of wealth already annuitized among 65-year-old single women in the US (Dushi and Webb 2004).²⁸ I show results for individuals with no bequest motive, with the (threshold) bequest motive that De Nardi (2004) shows to be consistent with the distribution of wealth in the US and Sweden, with the median (threshold) bequest motive that Ameriks et al. (2007) estimate based on consumption choices and survey responses,²⁹ and with the (linear) bequest motive that matches Hurd and Smith's (2002) estimates of anticipated bequests.

Typical bequest motives significantly reduce the demand for annuities. Without bequest motives, everyone above the bottom two deciles would buy annuities with ten percent loads, and people in the upper half of the wealth distribution would be willing to pay between \$4,500 and \$134,100 for access to these annuities. With any of the three bequest motives, however, the large majority of people are better off without available annuities and most of those who would buy annuities would gain little from them. Consider the results from the model with medical spending. Except for people in the top decile of the wealth distribution with De Nardi's (2004) bequest motive, nobody with any of the three bequest motives at any position of the wealth distribution is willing to pay more than \$2,730 for access to annuities with a ten percent load. If everyone had the bequest motive consistent with Hurd and Smith's (2002) estimates of anticipated bequests, only people in deciles three through six would buy annuities with a ten percent load, and nobody would be willing to pay even \$600 for access to these annuities. If everyone had De Nardi's (2004) bequest motive, only people in the top two wealth deciles would buy annuities; they would be willing to pay \$1,300 and \$12,300, respectively, for access to these annuities. Finally, if everyone had

²⁸The results would be similar if I used the distribution of wealth among single men. I use singles rather than couples because the model and the bequest motive estimates are based on individuals. Using the wealth deciles of 65-year-old couples, who are significantly richer than singles but have similar shares of already annuitized wealth, produces similar patterns but with lower demand for annuities with any of the three bequest motives.

²⁹I use the parameterization from Ameriks et al. (2008).

Ameriks et al.'s (2008) median bequest motive, people in three deciles would buy annuities with a ten percent load and nobody would be willing to pay more than \$2,730 for access to these annuities. Most people with typical bequest motives would be better off without available annuities.

The results are similar whether or not medical spending is included, as long as people are not too averse to Medicaid nursing homes.³⁰ Like Ameriks et al. (2008), I find that a strong precautionary motive (a large utility cost of running out of wealth in at least some states) can reduce the demand for annuities even without bequest motives, as people wish to hold a large stock of non-annuity wealth to protect against emergencies. Given the prevailing view that bequest motives cannot explain why people do not buy annuities, Ameriks et al. (2008) emphasize the role of the precautionary motive in reducing annuity demand. But as Brown and Finkelstein (2008) and Ameriks et al. (2008) themselves note, people who are very averse to Medicaid who do not also have strong bequest motives should buy long-term care insurance. So while significant aversion to Medicaid could explain the lack of annuity purchases, it is not consistent with the limited demand for long-term care insurance (owned by roughly ten percent of people over age 65). Together with my results, these findings suggest that bequest motives rather than medical spending risk is likely the primary factor limiting annuity purchases.

4 Discussion of results and conclusion

The simulation results suggest that one's demand for bequests should be a crucial determinant of whether he or she buys annuities. Empirically, however, ownership of life annuities is rare even among people who seem likely to have low demand for bequests. The main variables used as proxies for bequest motives are whether someone has children and the self-reported importance of leaving bequests. Table 1 summarizes these measures and how they relate to ownership of life

³⁰In principle, medical spending risk could increase or reduce the gain from annuities (Davidoff et al. 2005). It could increase the gain from annuities by effectively undoing some annuitization, or it could reduce the gain from annuities by increasing the demand for liquid (non-annuity) wealth.

Parental status			Importance of leaving an inheritance			
	% of sample	Own annuity		Children	No children	Own annuity
Children	92.4%	4.8%	Very	22.8%	20.4%	4.5%
No children	7.6%	5.7%	Somewhat	44.2%	34.4%	5.0%
Full sample	100%	4.8%	Not at all	28.6%	42.8%	5.1%
			Disagree	4.5%	2.4%	3.3%

Table 1: Proxies for bequest motives and ownership of life annuities in the Health and Retirement Study (HRS). All data are weighted using HRS household weights. “Disagree” means the respondent and his or her partner disagree about the importance of leaving an inheritance.

annuities in the Health and Retirement Study, a representative sample of people over 50 years old in the US.³¹ Annuity ownership is only slightly greater among households without children than households with children (5.7 percent versus 4.8 percent), and is only slightly greater among households who say that it is not at all important to leave bequests than those who say it is very important (5.1 percent versus 4.5 percent). Brown (2001b) finds that whether households have children and how important they say it is to leave bequests have little explanatory power for whether they plan to annuitize the balances of their defined contribution (DC) employer retirement plans.

The apparent inconsistency between the simulation results and the empirical results is likely due at least partly to the difficulty of identifying people with especially weak bequest motives.³² Available proxies are ill-suited to this task. Whether someone has children does not identify especially weak bequest motives. About 55 percent of people without children say it is somewhat or very important to leave bequests (versus 67 percent of people with children), and Hurd (1987)

³¹ Respondents are asked, “Some people think it is important to leave an inheritance to their surviving heirs, while others don’t. Do you (both) feel it is very important, somewhat important, or not at all important, (or do you differ in how important it is)?” The possible answers are that (both) think it is “very important”, “somewhat important”, or “not at all important”, or that the respondent and his or her partner disagree. This question was asked only in 1992, when most of the sample was between 51 and 61 years old. I measure annuity ownership rates in 2006 to include annuities purchased between 1992 and 2006. I include all private (non-pension) annuities that last for life. About one-third of reported annuities do not continue for life. Incidentally, only about one-fourth of reported annuities stop all payments when the owner dies. Most make payments to the owner’s spouse or heirs after the owner dies.

³² People who do not value bequests are likely to be better off buying available annuities, but the converse is not necessarily true. Although people who wish to leave bequests are likely to be better off without available annuities, they may buy annuities if the price is right or if they have some other reason to do so. One potential reason is tax incentives. Johnson et al. (2004) find evidence that many of the people who annuitize their Individual Retirement Accounts (IRAs) do so to avoid the ten percent tax penalty on early, non-annuitized withdrawals.

and Kopczuk and Lupton (2007) find that people with and without children have similar saving behavior in old age.³³ Similarly, the reported importance of leaving bequests apparently fails to identify especially weak bequest motives. Laitner and Juster (1996) find that some couples who say that it is not important to leave bequests choose joint life annuities with substantial guarantees, thereby reducing their income in exchange for bequest potential.³⁴

Bequest motives strong enough to eliminate purchases of available annuities are likely more prevalent than the reported importance of leaving bequests suggests. As Dynan et al. (2002) emphasize, non-contingent saving buys future consumption and medical spending in some states and bequests in others. For people who face significant spending risks, as retirees in the US do, the precautionary motive may dominate the bequest motive in determining how much they save even if they value bequests. Indeed, survey responses and calibrated life cycle models both indicate that, for most people, life cycle and precautionary motives are the primary determinants of saving (Dynan et al. 2002). My results show that the dominance of precautionary motives for saving is consistent with bequest motives playing a key role in limiting annuity purchases. Even bequest motives that have little effect on saving relative to life cycle and precautionary motives can have a large effect on the optimal mix of annuity income and non-annuity wealth. People who would leave small bequests were perfect insurance markets available or whose bequest motives have little effect on their saving—in other words, people who could rightly say that leaving bequests is not important to them—may be better off without available annuities. People need not have strong bequest motives or even value bequests as such to gain little from annuities; they need only view

³³People without children leave bequests mostly to their siblings (39 percent) and other relatives (45 percent) (statistics in this footnote are from Hurd and Smith's (2002) analysis of people in the US who are at least 70 years old). They also give more to friends (10 percent) and charity (6 percent) than people with children. The last surviving members of households with children leave the large majority of their estates to their children (92 percent). The rest goes mostly to other relatives (5 percent) and friends (2 percent). Less than one percent goes to charity. Even households with a surviving spouse give away about 20 percent of their wealth on average (to children if they have them and charity otherwise) upon the death of the first-dying spouse.

³⁴If the annuitant dies within the guarantee period, the insurer pays the annuitant's heirs for the remaining guarantee period. As Davidoff et al. (2005) note, guarantees are a strange way to leave bequests because they involve paying insurance loads to buy risky bequest prospects. But it is hard to understand why people without bequest motives would reduce their income to increase their expected bequests.

spending as having an opportunity cost that is not entirely contingent on their being alive.

The simulation results together with the evidence about bequest motives suggest that many people would not annuitize any wealth at available rates even if there were no reason other than bequest motives not to annuitize. That most people have family members with whom to share their lifespan risk (Kotlikoff and Spivak (1981) and Brown and Poterba (2000)), are fairly well annuitized by public and employer pensions (Dushi and Webb 2004), and face significant medical spending risk (Sinclair and Smetters (2004), Turra and Mitchell (2007), and Ameriks et al. (2008)) limits the market for annuities still further. It may be that more people than the few who do annuitize could benefit from annuitizing their wealth at available rates. Their failure to annuitize may be partly due to disadvantages inherent in small markets such as greater consumer search costs (including the cost of learning about an unfamiliar product).³⁵ Yet given that the desire to leave bequests seems widespread, that non-annuity wealth has benefits other than being bequeathable, and that most potential recipients of bequests would be better off if their benefactors annuitized less wealth, it seems likely that the potential gains from encouraging or mandating greater annuitization are small.

APPENDIX

A The strength of bequest motives

My primary measure of the strength of bequest motives is the demand for bequests if actuarially fair annuities were available. Figure 4 shows the correspondence between this measure and two alternatives. Panel (a) shows how bequest motives affect the optimal consumption path without annuities. The individual begins with \$300 thousand of total wealth, one-third of which is annu-

³⁵Mitchell et al. (1999) find that annuity prices in the private US market in 1995 varied by 20 percent, which suggests that search costs were substantial. Search costs may have declined since then because of the spread of the internet. See Brown and Goolsbee (2002) for evidence that the internet reduced search costs for term life insurance.

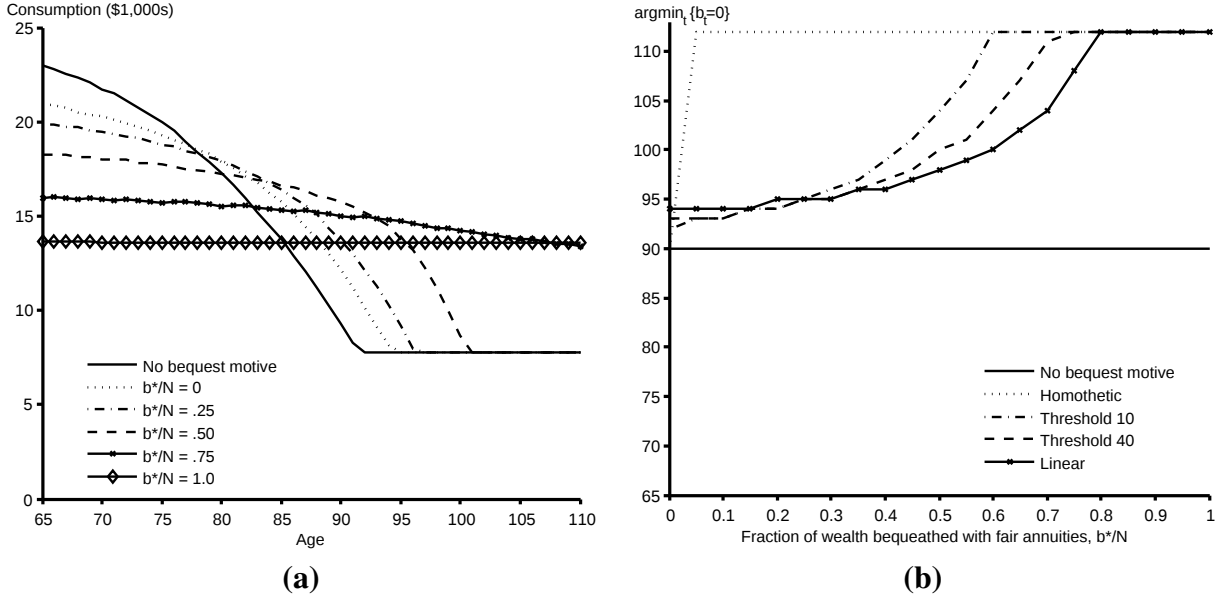


Figure 4: Panel (a) shows how the consumption path of an individual with \$300,000 of total wealth, one-third of which is annuitized, depends on the strength of his Threshold 40 bequest motive (roughly the bequest motive of an altruist who has a single, selfish heir with a 40-year planning horizon). Panel (b) shows the minimum age at which an individual exhausts his non-annuity wealth as a function of his bequest motive. In both panels, one-third of wealth is already annuitized.

itized, and has Threshold 40 bequest motives. Stronger bequest motives encourage the individual to postpone consumption—to consume less early on and *more* in later life—because money saved for consumption in old age has the added benefit of increasing bequests should the individual die before consuming it. The consumption path of an individual who would bequeath half of his wealth had he access to fair annuities and the consumption path of an individual without a bequest motive are qualitatively similar. In both cases, consumption basically declines at an increasing rate until it equals income, which occurs well before the maximum lifespan.

Panel (b) shows the age at which people without annuities exhaust their wealth (and thereafter leave zero bequests) as a function of how much they would bequeath were fair annuities available. People without bequest motives exhaust their wealth by age 90 and consume their income thereafter. People with stronger bequest motives save more and so take longer to exhaust their wealth, if they ever do: people at the 111 position at the top of the y-axis leave bequests even if they live to

the maximum age, 110. Aside from the Homothetic case, bequest motives that would lead people to bequeath one-fourth of their wealth had they access to fair annuities ($\frac{b^*}{N} = \frac{1}{4}$) delay the age at which people exhaust their wealth by five years relative to people without bequest motives, from 90 to 95 years old.

B Estimating the aggregate demand for annuities

B.1 The wealth distribution

Decile of total wealth	1	2	3	4	5	6	7	8	9	10
Total wealth (\$1,000s)	50	90	120	153	197	251	313	402	570	1,029
Annuitized wealth (%)	93	89	82	79	77	60	59	54	50	35
Non-ann wealth (\$1,000s)	4	10	22	32	45.4	100	128	185	285	669

Table 2: Average total wealth, the average fraction of wealth that is already annuitized, and average non-annuity wealth for each decile of the total wealth distribution for single women at age 65. Source: Dushi and Webb (2004).

Table 2 shows the values of total wealth and the fraction of wealth that is already annuitized that I use to estimate the gains from annuities for individuals at different points in the wealth distribution. These are decile averages of total wealth and the average share of wealth already annuitized among single, 65-year-old women in the US (Dushi and Webb 2004). Couples have similar shares of annuitized wealth but much more total wealth.

B.2 Preferences

Paper	Bequest motive	Preference parameters
Hurd and Smith (2002)	$v(b) = \theta b$	$\sigma = 2, \theta = 25.5^{-2}$
De Nardi (2004)	$v(b) = \phi_1 \left(1 + \frac{b}{\phi_2}\right)^{1-\sigma}$	$\sigma = 1.5, \phi_1 = -9.5, \phi_2 = 11.6$
Ameriks et al. (2008)	$v(b) = \frac{\omega}{1-\sigma} \left(\phi - c_{sub} + \frac{b}{\omega}\right)^{1-\sigma}$	$\sigma = 3, \omega = 26, \phi = 12, c_{sub} = 5$

Table 3: Bequest motives used in the calculations of the aggregate demand for annuities.

Table 3 shows the bequest motives I use to estimate the aggregate demand for annuities. With each bequest motive, I use the same utility of consumption function that was used in estimating or fitting the bequest motive. In the cases of De Nardi (2004) and Hurd and Smith (2002), utility of consumption is the same constant relative risk aversion function as in the baseline model, $u(c) = c^{1-\sigma}/(1-\sigma)$. In the case of Ameriks et al. (2008), utility of consumption is a constant relative risk aversion function of consumption above a subsistence level, $u(c) = (c - c_{sub})^{1-\sigma}/(1-\sigma)$, with $c_{sub} = 5$, i.e., \$5,000 per year.

I take the De Nardi (2004) and Ameriks et al. (2008) preferences directly from these papers. The De Nardi (2004) preferences match saving behavior and the wealth distributions in Sweden and the US. The Ameriks et al. (2008) preferences match consumption data and responses to a survey designed to identify bequest and precautionary motives for saving. What I refer to as the Hurd and Smith (2002) bequest motive is the bequest motive that in my model best matches Hurd and Smith's construction of average anticipated bequests in 1993 and 1995 given average wealth and average age. The same linear bequest motive that matches anticipated bequests in 1993 matches almost perfectly anticipated bequests in 1995.

B.3 Medical spending risk

I follow Brown and Finkelstein's (2008) model of medical spending risk except that I use a simpler Medicaid asset testing rule and year-long periods rather than months. The model is based on an actuarial model of transitions across health states developed by James Robinson.^{36,37} At any time, the individual is in one of five health states: healthy, requiring home health care, living in an assisted living facility, living in a nursing home, or dead. The (Markov) transition probabilities

³⁶As Brown and Finkelstein (2008) note, this model is widely-used in industry and government. See Robinson (2002) and Brown and Finkelstein (2004) for details.

³⁷Robinson (2002) estimates separate models for men and women. I report results based on the model for women because I use the wealth distribution for women and because it better approximates the risk facing single individuals. Wives typically outlive their husbands and provide them significant informal care as their health deteriorates. The results are similar, however, using the model for men.

across these states depend on the individual's current health status and age.

Individuals face exogenous medical spending requirements depending on their health status and age. When the individual is 65 years old, nursing homes cost \$52,195 per year (\$143 per day), assisted living facilities cost \$26,280 per year (\$72 per day), and skilled (registered nurse) and unskilled home health care costs \$37 and \$18 per hour. These are based on the average prices of long-term care services in the US (MetLife Mature Markets Institute 2002a,b). From this base, the price of each type of medical care grows by 1.5% per year in real terms, roughly the historical rate of growth of real wages and long-term care prices. Spending on home health care at any given age is the product of the hourly wage rates and the Robinson model estimates of care usage as a function of age. Medicare covers 35% of home health care spending and none of the costs of nursing homes or assisted living facilities in the model. Based on these prices and usage rates, home health care for a 70-year-old costs about \$5,518 per year, and home health care for a 90-year-old costs about \$17,120.

Nursing homes and assisted living facilities have some consumption value, e.g. from room and board. These facilities provide consumption worth \$6,180 (\$515 per month), the amount that the Supplemental Security Income (SSI) program paid single elderly people in 2000. Home health care has no consumption value.

Means-tested social insurance programs support people who cannot afford to pay for their medical care or achieve a certain standard of living. People who do not require facility-based care and who cannot afford to consume at least \$6,180 in any year receive transfers that enable them to consume exactly this much. People who do require facility-based care but cannot afford to pay for private care stay in Medicaid nursing homes. I report results for the case in which Medicaid nursing homes are perfect substitutes for private ones, i.e., they have the same consumption value of \$6,180 per year. As discussed in the text, making Medicaid nursing homes less attractive reduces the demand for annuities.

Due to means tests, people who receive social transfers cannot save and thus leave no bequest

if they die immediately thereafter. Following Medicaid's means-testing rules, annuity wealth, but not annuity income, is shielded from social insurance asset means-testing; people can maintain ownership of their annuity even if they receive government transfers. This makes annuities more attractive as a store of wealth.

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