

Dissertation draft

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Standard economic theory suggests that retirement annuities should be highly prized by individuals as a way to insure against the risk of late death Yaari (1965). However, in developed countries rates of annuitization are far below the levels that theory predicts. Under the coalition government in the UK the law regarding the use of private defined contribution pensions changed. Individuals were no longer forced to annuitise their pension pots and could access them in a variety of ways such as a lump sum withdrawal on retirement or income drawdown and subsequently the number of annuities sold in the UK dropped precipitously.

I first use the policy reform as a discontinuity to measure the impact of forced annutisation on the consumption of individuals in the first few years of retirement. Given that the reform was implemented suddenly and without advanced notice before the Spring 2014 budget I claim that individuals with a retirement year in 2015, 2016 or 2017 are otherwise similar to those with a retirement year in 2011, 2012 and 2013 but the do not need to annuitise their defined contribution pension pots.

In this paper I test two competing hypotheses for the annuity problem: bequests and pessimistic life expectancy. Depending on the reason for the lack of annuitization in the UK, the consumption response of retirees to the pension reform will differ. If individuals do not annuitise because of pessimistic life expectancy I will show that their consumption should increase. If, on the other hand, individuals do not annuitise because of a bequest motive, consumption should not change much as a result of the reform. I will solve lifecycle models for both of these cases and simulate consumption decisions with, and without, forced annuitization. I will then use a variety of empirical models to measure the consumption change in early retirement that resulted from the policy reform. The size and magnitude of this change will be indicative of the mechanism causing the annuitization problem.

The importance of retirement policy to individuals in the UK is growing. The number of individuals of pensionable age is expected to grow from 11.9 million in 2020 to 15.2 million in 2045 according to the latest ONS statistics and for every 1000 people of working

age there will be 341 of pensionable age in 20145 compared to 280 in 2020 ONS (2020). The increase in absolute and relative numbers of elderly makes retirement policy more important. Moreover, private, defined contribution (DC), pensions are becoming increasingly common and are predicted to grow as current cohorts age Cribb and Karjalainen (2023). Therefore, policies regarding how private pensions can be accessed will have a larger impact on overall welfare for retirees.

0.1 Literature review

My paper draws on three main strands of literature. The annuity problem, the retirement saving problem and lifecycle models. **this intro is rubbish**

Yaari (1965) was the first to show that under standard assumptions we would expect individuals to annuitise all of their wealth at retirement to insure against the risk of long life. Since then there has been much literature discussing possible reasons that people do not annuitise. Finkelstein and Poterba (2002) and Finkelstein and Poterba (2004) find evidence of adverse selection, thereby making the 'money's worth' of annuities lower for the general population as opposed to the population of annuitants. However, they also find that theory would still predict annuitization.

Friedman and Warshawsky (1990) show that annuitization decisions can be fully explained by a mixture of bequest motives and actuarially unfair annuities. They solve an augmented life-cycle model with a range of parameters on how severe the rate of return is on the annuity versus market rates. For plausible values they find that individuals would optimally not annuitise much wealth. Similarly to Finkelstein and Poterba (2004), Friedman and Warshawsky (1988) show that there is a significant difference between the life expectancy of annuitants and the general population in the American annuity market but this cannot fully explain the annuitization problem. Only when bequest motives are added to the model can annuitization rates be rationalized.

Lockwood (2012) builds on this and shows that a realistic bequest motive in lifecycle simulations achieves realistic annuitization rates. He solves a simple lifecycle model with bequest motives taken from several recent papers in the literature. The bequest motives he picks therefore match other important aspects of the lifecycle model such as how much individuals actually bequest and how rich individuals are when they bequest.

Lockwood (2018)

Vidal-Melia and Lejárraga-García (2004) have some interesting results. Need to talk about that.

There are some more papers to include here. Time to go and have dinner.

1 Data and Policy reform

1.1 Data

The main data set I use is the English Longitudinal Study of Ageing (ELSA) Banks et al. (2023). ELSA repeatedly interviews individuals over the age of 50 and asks them a range of questions relating to their income and wealth as well as expectations about the future. One benefit of using ELSA is that it includes data on pension type for individuals who are working. Therefore, I can differentiate between individuals who have a defined contribution pension and those who have a defined benefit contribution. Importantly it also includes information on pension size that the Institute for Fiscal Studies calculated, this is only available up until wave 5 at which point I use a real return of 3% to predict forward the pension wealth variable until retirement. ELSA also includes a measure of all non-housing financial wealth which I use in some specifications because of these issues with pension wealth. Because of slight differences between years in some of the ELSA questions I use 'Harmonized ELSA'¹ which ensures that variables are comparable across waves. Since this only includes a subset of the questions in ELSA I also supplement it with variables taken directly from the data such as questions that deal with life expectancy.

ELSA also includes questions on expenditures. In particular individuals are asked how much they consume on a range of broad categories including in-house food consumption, out-of-house food consumption, leisure consumption, clothes consumption and consumption on utility bills and rent. I use also use two questions on life expectancy that I discuss in more detail below.

I also use life tables from the UK's Office for National Statistics. These give us risk of death for each age group. I adjust them to make death certain at age 110 as is common in the literature. I transform these so that I have risk of death conditional on being a given age since this is what is used in the life cycle simulations.

To illustrate the effect the reform had on sales of annuities in the UK I obtained product data from the Financial Conduct Authority. These track the sale of different financial products overtime including data on annuity sales.

To calculate subjective life expectancies I follow O'Dea and Sturrock (2023). Individuals are asked "What are the chances that you will live to be age X or more?" where X changes depending on the age of the interviewee. If individuals were under 65 then X was 75, if individuals were 66 and older they were asked the age that was 11 to 15 years older than

¹"This analysis uses data or information from the Harmonized ELSA dataset and Codebook, Version G.2 as of July 2021 developed by the Gateway to Global Aging Data. The development of the Harmonized ELSA was funded by the National Institute on Aging (R01 AG030153, RC2 AG036619, R03 AG043052). For more information, please refer to <https://g2aging.org/>."

them and is a multiple of 5. From wave three respondents were also asked “What are the chances that you will live to be age 85 or more?” if they were under 70. As most recent retirees are under 70 we therefore have two data points. I carry out the following procedures: drop any individuals who think it is more likely they reach an older age than a younger age since; add, as a third data point their objective chance of reaching 110 according to the ONS life tables; fit these three points to a Weibull distribution using non-linear least squares. Then I create subjective survival tables.

I could go into more detail here? Maybe I should. Add equation etc

1.2 Policy reform

Successive governments in the UK have attempted to reform both the public and private pension system. Prior to 1987 participation in private schemes was limited to employees of firms that had offered one, and there were few alternatives to the public state pension or defined benefit scheme that a public sector employee would offer. From 1989, individuals in the UK were allowed to open tax advantaged self-invested personal pensions alongside any pension their employer offered. The largest reform prior to 2014 came in the 2004 Finance Act which rationalised taxation rates on different types of pensions. However, defined contribution pension pots could still only be used to buy an annuity after taking out a maximum of 25% as a tax free lump sum withdrawal.

Announced in the Spring budge of 2014, the so called ”pensions freedom act” received Royal Asset in December 2014 marked the end of a series of pension reforms carried out by the coalition government between 2010 and 2015. The reform was announced in the Spring budget and made it possible to withdraw money from a private pension pot subject to the marginal rate of income tax that an individual faced. In the June 2010 budget the government made a first reform to the annuitization rules, creating an minimum income requirement above which individuals would not need to annuitise more HMT (2011). However, this was set at £20,000 and therefore few individuals were eligible. The minimum income requirement was scrapped in the 2014 bill finally eliminating the compulsory annuities market. The impact of the reforms on annuity demand has been documented by Cannon et al. (2016). Using data from the Association of British Insurers they show that annuity demand dropped by 75% from its maximum.

After the announcement in spring 2014 sales of annuities dropped massively and income drawdown products increased. However, pension pots could also be taken out in one go and this became a much more common option for many people.

Figure 1 shows purchases of annuities overtime and demonstrates the sharp decrease in purchases that happened from 2014 to 2015. Likewise there was an increase in the number of pensions that were being accessed using an income drawdown product, but these do

not fully account for the drop in annuitisation. So, either they are withdrawn at once or they are left alone.

Figure 1: Pension pots accessed

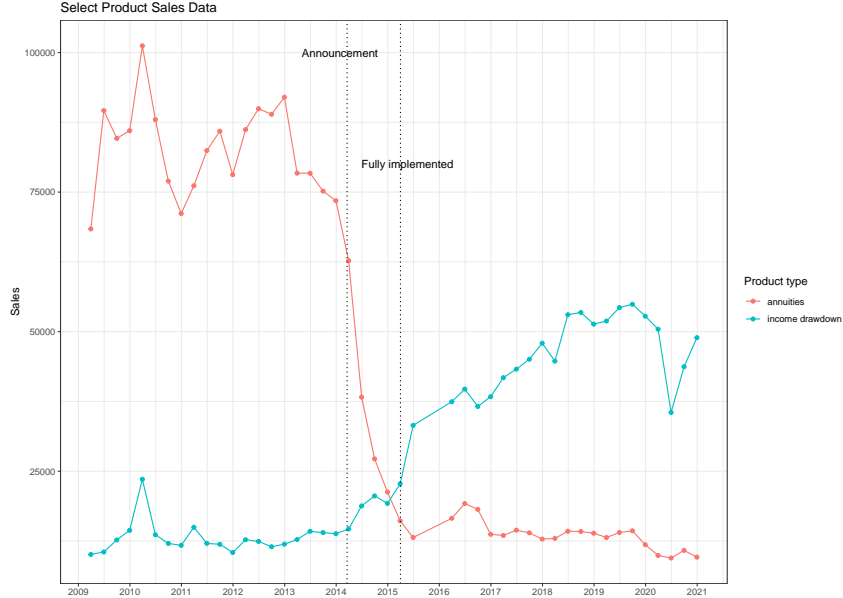


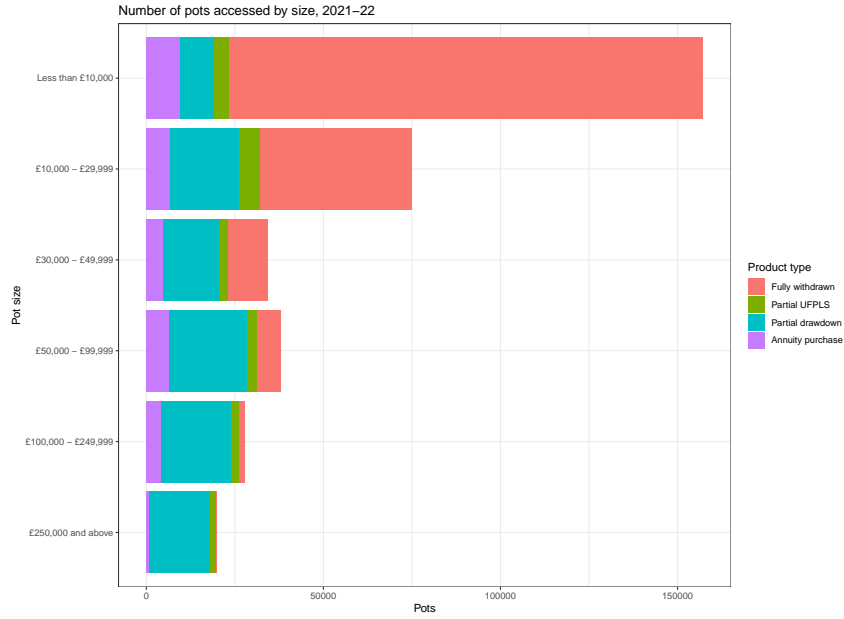
Figure 2 shows the current distribution of how pension pots are first accessed at retirement. In 2021, 196,736 pots were fully withdrawn at retirement, accounting for over 50% of pots, prior to the policy reform this was not the case and most defined contribution pensions were accessed through annuities.

Also of specific interest to the annuity market was the European Union’s ‘Equal Treatment in Goods and Services Directive’ of 2004. This prohibited discrimination in the provision and cost of good and services based on sex. Up until 2011 there was a clause that stated insurers were allowed to charge different premiums if it was based on evidence that sex is correlated with different amounts of risk. However, in March 2011 the European Court of Justice ruled that insurers were not allowed to charge different amounts and gave them until December 2012 to implement the ruling. This change meant that annuity products could no longer be priced differently for men and women in the UK. However, given this change was implemented two years before the pension freedoms act, I can still identify the impact of the pensions freedom act on early retirement consumption.

1.3 Covariate Balance

Table 1 shows various summary statistics for each variable of interest from ELSA and the ONS. First note that the second retirement group is small with just 728 non missing observations for gender as opposed to 941 individuals in the control group. The control

Figure 2: How pension pots are accessed



group are less female, retired at a slightly younger age and expected to retire slightly earlier. This could be because this period was affected by the increase in the state pension age for women from age 60 in 2010 to age 65 in 2018. Since this change happened gradually and occurred over the whole period I do not expect it to influence the results. The DifferenceAge row tracks the difference between expected and actual pension age.

As required, retirement year is between 2011 and 2013 for the treatment group and 2015 and 2017 for the control group. However, as discussed above their interview date is after or the same as the retirement year because we are tracking consumption in retirement.

The treatment group has higher financial wealth with a median of £65,000 at time of interview as opposed to £55,000 in the control group. Likewise, the second group are more likely to have held at defined contribution pension at some point and have much more money in them. Both groups are equally likely to have a defined benefit pension with roughly 44% of individuals across both samples having a defined benefit pension. Individuals are much more likely to have a DB pension than a DC pension which reflects the fact that retirees now are still more likely to have a DB pension although the number with DC pensions are growing. Home ownership is roughly equal across groups although the second group have slightly more housing wealth.

Both groups are objectively similarly long-lived according when using ONS life tables to calculate life expectancy based on gender, age and the year the interview was carried out in. Subjective life expectancies are also similar across groups, with individuals expecting to live another 21 years as opposed to the 24 that the ONS would expect them to live.

Maybe add in prob of survival to age 85 or 90 or something Also add in an indicator for living alone or living with someone else

Unfortunately, some consumption data is missing for some individuals. The food categories have the least missing data and the leisure consumption category has the most missing data. **Check why total consumption adds up to so much more than all the categories added together? Do they include rent and housing in consumption?**

Overall, the groups do appear to be slightly different with the treatment group being richer and slightly more likely to have DC pension wealth. On key demographic characteristics though the groups are similar, the difference in retirement age between the two groups can be mostly explained by the difference in expected retirement age meaning that individuals have not on-mass decided to delay retirement and avoid annuitisation.

Table 1: Summary statistics

	Max		Mean		Median		Min		Non Missing			
	Control	Treat	Control	Treat	Control	Treat	Control	Treat	Control	Treat	Control	
∞	Gender	1.0	1.0	0.455	0.493	0.0	0.0	0.0	0.0	941	728	0.498
	RetirementYear	2013.0	2017.0	2011.878	2015.865	2012.0	2016.0	2011.0	2015.0	941	728	0.763
	InterviewYear	2016.0	2019.0	2013.306	2017.357	2014.0	2017.0	2011.0	2015.0	941	728	1.188
	YearsSinceRetirement	2.0	2.0	1.040	0.999	1.0	1.0	0.0	0.0	941	728	0.738
	RetiredAge	82.0	81.0	62.918	63.750	63.0	64.0	47.0	50.0	941	728	4.441
	AgeAtInterview	83.0	82.0	63.959	64.749	64.0	65.0	49.0	51.0	941	728	4.467
	ExpectedRetiredAge	120.0	120.0	62.282	62.639	60.0	60.0	54.0	50.0	724	609	5.320
	DifferenceAge	48.0	57.0	-0.682	-1.205	-1.0	-1.0	-8.0	-22.0	724	609	4.423
	FinancialWealth (thousands)	1910.5	2890.0	120.487	167.023	54.9	65.6	-77.0	-33.0	912	721	210.588
	DCPension	1.0	1.0	0.197	0.257	0.0	0.0	0.0	0.0	941	728	0.398
	DCValue (thousands)	8171.7	18367.9	73.920	128.958	0.0	0.0	0.0	0.0	832	598	462.933
	DBPension	1.0	1.0	0.438	0.434	0.0	0.0	0.0	0.0	941	728	0.496
	StatePension	19.1	27.6	4.576	4.774	5.8	6.1	0.0	0.0	934	724	3.990
	OwnsHouse	1.0	1.0	0.872	0.890	1.0	1.0	0.0	0.0	938	727	0.334
	HouseValue (thousands)	1300.0	3000.0	232.313	310.218	200.0	260.0	0.0	-143.0	941	728	181.210
	ObjectiveLifeExp	38.0	38.6	23.840	23.721	23.9	23.4	7.9	8.8	941	728	4.472
	SubjectiveLifeExp	36.6	37.9	20.902	21.129	21.2	21.3	4.6	4.1	638	463	6.411
	TotalConsump	435526.0	4602.3	2427.470	796.235	648.8	702.8	130.2	136.9	768	304	27132.273
	FoodConsump	1938.1	2738.1	414.373	439.469	362.4	397.4	31.7	36.1	929	714	237.020
	FoodConsumpIn	440.0	400.0	80.059	80.884	70.0	70.0	1.0	1.0	930	714	48.230
	FoodConsumpOut	750.0	1500.0	66.550	88.406	50.0	50.0	0.0	0.0	937	722	78.103
	ClothingConsump	1450.0	2000.0	87.642	83.045	40.0	40.0	0.0	0.0	825	332	135.286
	LeisureConsump	530.0	150.0	84.940	75.000	60.0	75.0	0.0	0.0	744	2	86.702
	UtilityConsump	483.1	580.9	108.034	112.850	96.0	100.0	0.0	0.0	785	308	59.960

As a further test for balance I regress demographic and financial characteristics of individuals on year of birth and the treatment dummy. We can then see if the treatment groups differ on key characteristics such as financial wealth or retirement age. For a regression discontinuity to be valid we need the treatment and control groups to be similar along all other characteristics apart from the treatment variable.

In particular I run:

$$Y_i = \alpha + \beta Post_i + \gamma YOB_i + \kappa(Post_i \times YOB_i) + \epsilon_i$$

Table 2 shows these results. We can see that being in the treatment group, con

A key threat to validity is manipulation of the running variable. This is probably quite a threat in our case as individuals could delay retirement and/or the purchase of an annuity until after the reform. To check whether this is occurring we see whether the difference between real retirement age and the first expected retirement age recorded in the data are different for those retiring before 2014 compared to those retiring after 2014. As shown above in Table 1 this not the case. However, since we do not have data on the exact purchase date of the annuity we cannot track whether annuity purchases were delayed because of this. However, we do still relatively stable annuity demand before the policy reform. If individuals delayed annuity purchases in expectation of the reform we would see steady declines in purchases before the reform was announced.

2 Empirical models

In this section I outline the key empirical models I run with both the simulated consumption data from the lifecycle models and with the real data from ELSA. I then see which lifecycle model better fits the consumption response that happened as a result of the pension reform.

I use a regression discontinuity design where I compare the consumption of recent retirees after the policy reform to recent retirees before the policy reform. The key assumption implicit in regression discontinuities is that nothing else changes at the time of the jump apart from the policy of interest. And that the policy occurs without individuals predicting it and changing their behaviour. As I have argued above the demographic information in the data suggest that individuals did not delay retirement and that there was no delay in annuitisation as shown by the quick and sudden decline in annuity purchases. Moreover, anecdotal evidence from media and business sources at the time of the announcement were all surprised by the policy changes, with some financial planners even complaining that they had not been briefed.

Table 2: Covariate Balance

	Pt. est.	SE
Gender	2.243	10.468
RetirementYear	-12.528	16.127
InterviewYear	-11.243	24.959
YearsSinceRetirement	9.716	16.056
RetiredAge	-12.528	16.127
AgeAtInterview	-2.811	22.725
ExpectedRetiredAge	-240.427	129.345
DifferenceAge	-246.763	128.979
FinancialWealth (thousands)	-4769.638	5410.054
DCPension	-13.608	8.933
DCValue (thousands)	-1978.144	20284.768
DBPension	7.974	10.386
StatePension	67.008	71.043
OwnsHouse	-0.697	6.968
HouseValue (thousands)	6630.186	4775.236
ObjectiveLifeExp	13.086	30.559
SubjectiveLifeExp	0.351	182.705

Retirement year is the running variable and individuals are treated if retirement year is greater than 2014 and less than or equal to 2017. I use consumption data of individuals up to 2 years into retirement so that the sample size is larger. So if someone retired in 2015 and had consumption data in 2015 and 2017 I include both values. An individual is considered not treated if they retire before 2013 and after 2011. To account for the fact that the reform only impacted individuals who had accumulated defined contribution pension pots I interact the treatment dummy with an indicator variable signalling whether the individual had ever held a DC pension pot.

Because of the differences in financial characteristics between the groups I add controls for financial wealth, housing wealth and whether an individual owns their own home. I also run regression discontinuity with s

$$Cons_{it} = \gamma X_{it} + \beta PostReformDC_{it} + \epsilon$$

And X_{it} is a set of controls.

Table 3: DC Only

	TotalConsump	FoodConsump	FoodConsumpIn	FoodConsumpOut	ClothingConsump
(Intercept)	1327.501 (746.237)	543.715 (337.842)	71.897 (67.617)	214.243 (117.732)	54.031 (201.504)
pre_post_refreat	73.892 (67.157)	3.254 (26.366)	-1.374 (5.223)	11.117 (9.016)	26.921 (23.977)
retired_age	-4.649 (10.437)	-3.297 (5.460)	-0.101 (1.096)	-2.584 (1.889)	-0.292 (3.614)
fin_wealth	0.229 (0.114)	0.173 (0.050)	0.013 (0.010)	0.111 (0.025)	-0.012 (0.052)
gendermale	19.635 (62.688)	37.100 (27.934)	7.336 (5.469)	5.995 (10.113)	-13.219 (24.657)
dc_pot	-0.011 (0.008)	0.004 (0.007)	0.002 (0.001)	-0.004 (0.001)	-0.003 (0.003)
years_since_retirement	-1.663 (43.909)	-7.382 (16.742)	-0.148 (3.220)	-7.745 (6.173)	6.264 (14.367)
owns_house	-261.372 (195.477)	102.718 (37.853)	21.363 (7.286)	10.643 (14.801)	73.742 (16.508)
public_pension	-14.029 (9.524)	-3.772 (4.130)	-1.176 (0.849)	1.255 (1.251)	-3.033 (4.033)
Num.Obs.	209	326	326	330	221
R2	0.068	0.063	0.046	0.102	0.035
R2 Adj.	0.031	0.039	0.022	0.079	-0.002
AIC	3154.1	4499.9	3452.0	3834.7	2895.0
BIC	3187.6	4537.8	3489.9	3872.7	2929.0
Log.Lik.	-1567.067	-2239.962	-1716.008	-1907.357	-1437.512
RMSE	436.59	233.25	46.75	78.33	161.68
Std.Errors	HC3	HC3	HC3	HC3	HC3

Table 3 shows the results of this specification on the various consumption indicators. Column one has total monthly consumption as variable on the left hand side of the regression equation. We can see that being in the treatment group is associated with £83 more a week in spending overall across all categories of expenditure. This is not statistically significant using robust standard errors (find a reference for the SE that I use). Being older at the time of interview is also associated with lower consumption whilst those who retired later have lower consumption because years since the start of retirement is associated with higher total consumption.

Columns 2 through 4 use food consumption as the outcome variable. Interestingly food consumption in the house does not increase as a result of the policy reform but food outside the house does increase. If individuals see their pension pot, that they previously could not access, as a shock to their wealth, like winning the lottery, then we would the consumption basket to include more goods that are perceived as luxuries. Likewise, consumption on clothing, shown in column 4 increases as a result of the policy change.

I now run another specification which seeks to control for some of the cohort effect that could be driving these results instead. As the financial characteristics in 1 show, the treatment group has higher levels of wealth than the untreated group. To test for cohort effects I add individuals who have a defined benefit pension pot into the model and interact the policy change with a dummy for having a defined contribution pension pot. This makes the coefficient of interest the interacted term, which shows us the difference in the change in consumption between the DB and DC group. Since rules for defined benefit pensions did not change under the pensions freedom act, this group can be seen as a natural counterfactual group to judge the consumption of the defined contribution group against.

3 Life cycle theory

In the second part of the paper I first solve a modified retirement lifecycle model and then use data from the solved lifecycle model lifecycle consumption . The problem that retirees face is as follows. Every period retirees solve:

$$V_t(a_t, y) = \max_{a_{t+1}, c_t} \{u(c_t) + p_t B(a_{t+1}) + \beta(1 - p_t)V_{t+1}(a_{t+1}, y)\}$$

subject to their budget constraint

$$c_t = a_t(1 + r) - a_{t+1} + y$$

where a_t are asset holdings in time t , y is constant income for all periods and . Income can come either from state pensions, defined benefit pension plans or purchased

annuities.

$$u(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma}$$

In some specifications retirees can leave bequests, I use the bequest function from Lockwood (2012).

$$B(a_t) = \left(\frac{m}{1-m}\right)^\sigma \frac{\left(\frac{m}{1-m}c_0 + a_t\right)^{(1-\sigma)}}{1-\sigma}$$

Where b_t is the amount left at death, m is a measure of bequest motive strength and c_0 is a minimum amount of consumption that individuals want. **Check this**

First, I discretise the state space. I create a grid from 500 to 50,000 incrementing by 500 for income and 1000 to 500,000 incrementing by 1000 for financial assets. I solve the retirees problem using backward induction. At age 110 there is certainty of death so any leftover assets are carried over into the next period and bequested. This means that the value at the end of the final period is either 0 (if we do not allow a bequest motive) or the value of bequests. I then take this value function and solve an individuals final period problem, choosing assets next period (i.e. those to bequest) and how much to consume.

Using the optimal policy function in the last period, I calculate the value of the last period, which the utility function and the value function evaluated at the maximum. This is then used in the problem the year before that. I repeat this process back to the age of retirement to obtain optimal consumption amounts for each year of retirement and associated value functions.

To simulate the ELSA data I solve this retirement problems for each new retiree in the data set dependent on their objective probability of death each period. I estimate with subjective life expectancies and objective life expectancies, I also estimate the model both with and without a bequest motive which was picked to fit the unforced real annuity rates seen in the data. I then estimate several empirical models with the simulated data.

In retirees first year of retirement I allow them to choose to annuitise some of their wealth. In practical terms this is moving down the asset grid but up the income grid and seeing if the value of being in that position is better than where the individual is currently. To calculate this trade-off I calculate the annual annuity payment that follows from a given annuity cost. I calculate this using objective life tables from the ONS using the following equation:

$$Ann = \delta * C * \left[\sum_{t=Retage}^{110} \frac{1 - p_{t|Retage}}{(1+r)^{t-Retage}} \right]^{-1}$$

Where C is the one-off payment, δ is a factor that controls the 'money's worth' of annuity

and $p_{t|Retage}$ is the probability of death at age t conditional on being age *Retage*. So individuals can move C on the asset grid for gaining Ann on the income grid for the rest of their lives.

I also simulate the expected change in consumption given forced annuitisation and no annuitisation. The benefit of simulating an individuals decision is that we can directly compare what they would have consumed with what they actually consumed.

3.1 Rough plan

- Intro
 1. I think Eric French wrote something about population that I could use in then intro to say why it is important.
 2. "Latest data from HM Revenue Customs (published in April) showed more than £45bn has been taken from pots since 2015." <https://www.ftadviser.com/pensions/2022/04/freedoms-were-they-really-a-good-idea/>
 3. Add bit about DC/DB pensions in the intro. Also talk about heterogeneity across countries. Some countries want to move towards more annuitisation. This annual review is a good source of info Banks and Crawford (2022)
 4. <https://www.moneysavingexpert.com/savings/pension-freedom/>
- Lit review
- Models
- Empirical
 1. Diff in diff
 2. RDD
 3. Matching?
 4. can I use anything I learnt in panel? In some sense the decision to annuitise is a discrete choice problem so I could use something from there.
- Conclusion

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