Retirement Consumption: Evidence from UK Pension Reform

INSERT NUMBER HERE

July 2023

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Classical economic theory suggests that retirement annuities, which provide a guaranteed income stream until the end of life, should be highly valued by individuals as a way to insure against late death Yaari (1965). However, in developed countries, rates of annuitisation are far below the levels that theory predicts - this phenomenon has been termed the "annuity puzzle". The literature has suggested several reasons for this, but there is no consensus about which mechanism is dominant. I exploit early retirees' consumption responses to a reform to annuity policy in the UK to add to this literature. [**Add something once I have a conclusion**].

In the UK, adults have three methods of funding retirement: the state pension; defined benefit (DB) employee pension schemes, which provide an income in retirement based on years of service and a function of wages; and defined contribution (DC) pensions, under which individuals save and invest in a tax-advantaged account that is usually supplemented with employer contributions. Under the 2010-2015 coalition government in the UK, the law regarding the use of private DC pensions at retirement 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 or income drawdown, involving a steady withdrawal of assets from the pension pot – common advice is to take 4% a year. Subsequently the number of annuities sold in the UK dropped precipitously.

In this paper, I first use the policy reform as a discontinuity to measure the impact of forced annuitisation on the consumption levels 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 who retired in 2015, 2016 or 2017 are otherwise similar to those who retired in 2011, 2012 and 2013 except for the fact the later retirees do not need to annuitise their DC pension pots. Therefore, I can use a regression discontinuity to identify the effect that forced annuitisation has on the consumption of retirees.

I then test two competing hypotheses for the annuity puzzle: bequests and pessimistic life expectancy. The annuity puzzle was first identified by Yaari (1965) and is a classed as a problem since standard economic theory cannot explain the lack of annuitisation that is observed in the real world. Two possible explanations are bequests and life expectancy: individuals want to leave an estate for their heirs to inherit and they cannot do this if they annuitise their wealth; or individuals may believe they will not live as long as annuity providers think they will and therefore annuities that are on the market do not appear to be good value. Depending on the reason for the lack of annuitisation in the UK, the consumption response of retirees to the pension reform will differ. If individuals do not annuitise because of pessimistic life expectancy their consumption should increase after the reform. 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 (**maybe add something about lifecycle models here**) for both of these cases and simulate consumption decisions with and without forced annuitisation. I will then use a variety of empirical models to measure the consumption change in early retirement that resulted from the policy reform. The sign and magnitude of this change will be indicative of the mechanism causing the annuitisation problem.

The importance of retirement policy to individuals in the UK is growing. The number of individuals of pensionable age is expected to increase from 11.9 million in 2020 to 15.2 million in 2045 according to the latest projections from the Office for National Statistics (ONS) and for every 1000 people of working age there will be 341 of pensionable age in 2045 compared to 280 in 2020 ONS (2020). The increase in absolute and relative numbers of elderly people makes retirement policy more consequential. Moreover, private 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.

Moreover, understanding how retirees spend their money over retirement is an important policy question of its own. If retirees spend too much in early retirement, the state may need to provide for them towards the end of their lives. This has implications for government budgets, especially since population aging means more individuals will require expensive end of life care. On the other hand, if retirees over-save and do not spend, the economy may be dynamically inefficient whereby the capital stock is too high because individuals save too much for retirement and for bequests. In this case consumption per capita could be increased if savings were decreased.

0.1 Literature review

My paper builds on three main strands of literature: that of the annuity puzzle, exploring reasons that some retirees choose not to annuitise; the retirement saving puzzle, which seeks to explain why retirees drawdown assets slowly, ; and lifecycle models, whereby the above problems are explained using a tractable model of human decision making.

Yaari (1965) showed 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 annuitisation.

Friedman and Warshawsky (1990) show that annuitisation decisions can be fully explained by a mixture of bequest motives and actuarily 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 annuitisation puzzle. Only when bequest motives are added to the model can annuitisation rates be rationalized.

Lockwood (2012) builds on this and shows that a realistic bequest motive in lifecycle simulations achieves realistic annuitisation 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 I will include here.

1 Data and Policy reform

1.1 Data

The main dataset I use is the English Longitudinal Study of Ageing (ELSA) Banks et al. (2023). ELSA picks individuals over the age of 50 to survey every two years until death. If individuals leave the survey, ELSA replaces them so that it is representative of the over 50 population in the UK. Individuals are asked 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 types for individuals who are working. Therefore, I can differentiate between individuals who have a DC pension and those who have a DB pension. There have been 9 waves of ELSA data collection – the first was in 2001 and collections happened every two years thereafter.

Importantly, ELSA also includes information on pension size calculated by the Institute for Fiscal Studies (IFS). This is only available up to and including wave 5 (which was collected in 2010 and 2011) 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 data. Due to slight differences in the ELSA questions between years, 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 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 across 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 also use 'life tables' from the UK's ONS. These provide me with the risk of death for each age group. Since the tables are produced until age 120, I adjust them to make death certain at age 110 as is common in the literature O'Dea and Sturrock (2023). I transform these so that I have risk of death conditional on being a given age since this is what I use in the life cycle simulations. I also use these objective probabilities to calculate annuity prices for individuals.

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

Life expectancy impacts the decision to annuitise for two reasons. Firstly, it directly

[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/.

impacts the price that an annuity will cost for individuals. Older individuals and those with pre-existing health conditions generally can buy an annuity that provides a greater income stream than individuals who are younger. Secondly, private information about life expectancy impacts the perceived value of an annuity. If an individual expects to outlive the general population, an annuity, at a given price, will appear a much better deal to them. Likewise, an individual's life expectancy will change their decision on how to consume and save through retirement.

To calculate subjective life expectancies from ELSA data, I follow O'Dea and Sturrock (2023). Individuals were asked "What are the chances that you will live to be age X or more?" where X changed 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 them and a multiple of 5. From wave 3 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 first drop from the data individuals who think it is more likely that they reach a higher age than a younger age since this shows a misunderstanding of the question. I then add as a third data point their objective chance of reaching 110 according to the ONS life tables. I fit these three points to a Weibull distribution, which is commonly used by demographers to estimate how populations will age, using non-linear least squares. Then I create subjective survival tables using parameters from the Weibull distribution.

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 them, and there were few alternatives to the public state pension or DB scheme that a public sector employer 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 2004 Finance Act rationalised taxation rates on DB and DC pensions. The rules for DC pension pots were such that individuals had to buy an annuity after optionally taking a maximum of 25% of the pot as a tax free lump sum withdrawal. DC pension pots were accessible from age 55 and most required that they be accessed before the age of 75.

In the June 2010 budget, the coalition government made the first of two key reforms it would make to the pension system between 2010 and 2015. The 2010 policy reform created a minimum income requirement above which individuals would not need to annuitise more HMT (2011), this meant high income retirees would not need to annuitise their wealth. The income requirement was set at £20,000. This meant, for example, that an individual who was a member of a DB scheme paying them £20,000 a year would not need to annuitise their DC pension pot. However, the relatively high minimum income requirement meant that most individuals still had to purchase an annuity.

In spring 2014, George Osbourne announced the so called 'pensions freedom act' scrapping the minimum income requirement and eliminating the compulsory annuities market HMT (2014). One government minister infamously brought the message home by saying pension pots 'can be used to buy Lamborghinis' if retirees wanted to Watt and Elliott (2014). The government also announced plans to make switches between DB and DC pension schemes possible although this was only realised in the next parliament – future research could explore the impact of this second reform on the consumption and saving decisions of retirees.

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 in 2011. Figure 1 shows purchases of annuities overtime and demonstrates the sharp decrease in purchases that happened from 2014 to 2015. There was an increase in the number of pensions that were being accessed using an income drawdown product, but these only partly account for the drop in annuitisation as is shown by the graph.

Figure 2 shows the distribution methods to access pension pots at retirement in 2021-22. 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 – 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 goods 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

Figure 1: New pension pots accessed

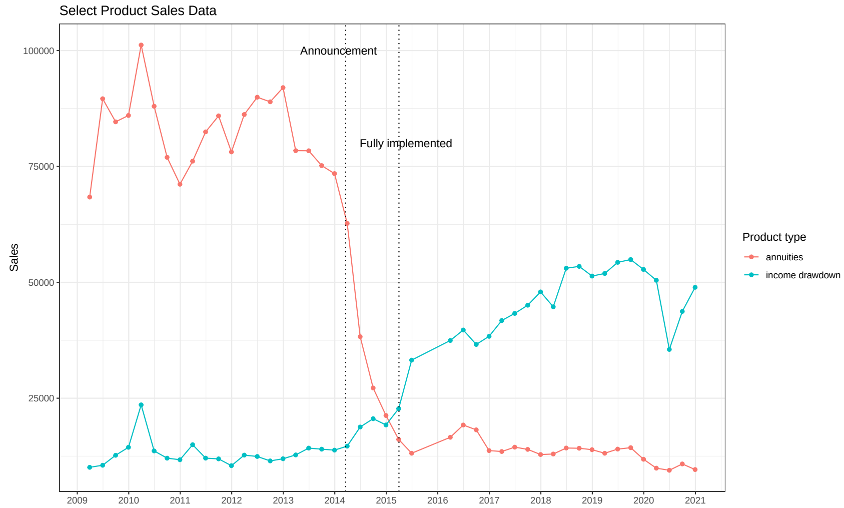
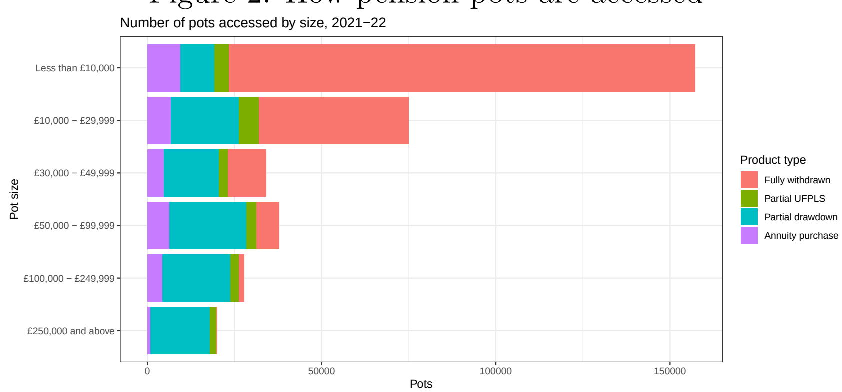


Figure 2: How pension pots are accessed[2]



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 that this change was implemented two years before the pension freedoms act it will not impact my results.

1.3 Covariate Balance

Table 1 shows various summary statistics for each variable of interest from ELSA and the ONS.

[2]Partial UFPLS (uncrystallised funds pension lump sum) is similar to Partial drawdown but with a different tax schedule. With partial drawdown you take the whole 25% tax free amount at once whereas with UFPLS you only claim the tax relief on 25% of the amount you are taking out. This option is better if you may want to buy another retirement product in the future such as an annuity.

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

The second retirement group, those who retired post-reform, is small with just 728 non missing observations for gender as opposed to 941 individuals in the control group. The control group are more 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 ocurred over the whole period I do not expect it to influence the results. The DifferenceAge row tracks the difference between expected and actual retirement age.

The treatment group has higher financial wealth with a median of £66,000 at the time of interview as opposed to £55,000 in the control group. Likewise, the second group are more likely to have held a DC pension at some point and have much more money in them. Both groups are equally likely to have a DB pension with roughly 44% of individuals across both samples having a DB pension. In general, DB pensions are more prevalent than DC pensions in the data, this reflects the same trend that is observed in the general UK population. Home ownership is roughly equal across groups although the second group have slightly higher housing wealth.

Both groups are similarly long-lived 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.

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.

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

Overall, the groups appear to have slightly different wealth profiles with the treatment group being richer and slightly more likely to have DC pension wealth. On key demographic characteristics, however, 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 en masse decided to delay retirement and avoid annuitisation. Moreover, for the regression discontinuity models I only use individuals who have a DC pension so it does not matter that there are more individuals with DC pensions in the second group.

Table 1: Summary statistics

	Max		Mean		Median		Min		Non Missing	
	Control	Treat	Control	Treat	Control	Treat	Control	Treat	Control	Treat
Gender	1.0	1.0	0.468	0.495	0.0	0.0	0.0	0.0	765	303
RetirementYear	2013.0	2017.0	2011.873	2015.386	2012.0	2015.0	2011.0	2015.0	765	303
InterviewYear	2016.0	2017.0	2013.328	2016.323	2014.0	2016.0	2011.0	2015.0	765	303
YearsSinceRetirement	2.0	2.0	1.061	0.528	1.0	1.0	0.0	0.0	765	303
RetiredAge	82.0	79.0	62.868	63.812	63.0	64.0	47.0	54.0	765	303
AgeAtInterview	83.0	79.0	63.929	64.340	64.0	64.0	49.0	54.0	765	303
ExpectedRetiredAge	120.0	120.0	62.318	62.711	60.0	60.0	54.0	50.0	607	266
DifferenceAge	48.0	44.0	-0.619	-0.970	-1.0	-1.0	-8.0	-22.0	607	266
FinWealth(£000s)	1910.5	2037.0	121.953	168.196	54.5	67.2	-32.0	-19.8	750	299
DCPension	1.0	1.0	0.195	0.257	0.0	0.0	0.0	0.0	765	303
DCValue(£000s)	8171.7	17313.5	73.121	115.168	0.0	0.0	0.0	0.0	686	260
DBPension	1.0	1.0	0.463	0.459	0.0	0.0	0.0	0.0	765	303
StatePension	19.1	14.6	4.569	4.537	5.7	5.9	0.0	0.0	762	300
OwnsHouse	1.0	1.0	0.876	0.881	1.0	1.0	0.0	0.0	765	303
HouseValue(£000s)	1300.0	1700.0	229.589	297.154	200.0	250.0	0.0	-143.0	765	303
ObjectiveLifeExp	38.0	34.1	23.900	23.966	23.9	23.5	7.9	10.8	765	303
SubjectiveLifeExp	36.6	37.9	21.014	21.011	21.3	21.2	4.6	5.3	532	200
TotalConsump	2925.1	3495.7	729.638	783.674	647.6	701.4	130.2	136.9	765	303
FoodConsump	1938.1	1938.1	416.711	425.607	364.2	374.9	51.5	36.1	760	298
FoodConsumpIn	440.0	400.0	80.104	77.671	70.0	70.0	1.0	1.0	761	298
FoodConsumpOut	750.0	1200.0	68.649	88.187	50.0	50.0	0.0	0.0	764	300
ClothingConsump	1450.0	2000.0	89.735	86.241	48.0	40.0	0.0	0.0	765	303
LeisureConsump	530.0	150.0	82.703	75.000	60.0	75.0	0.0	0.0	666	2
UtilityConsump	483.1	580.9	108.473	113.714	96.0	100.0	0.0	0.0	765	303

As a further test for balance I regress demographic and financial characteristics of individuals on 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:

$$Y_i = \alpha + \beta PostRef_i + \epsilon_i$$

Where Y_i are the different demographic and financial characteristics.

Table 2 shows these results. As expected, retirement year and interview year are greater for the treated group. The difference between expected and real retirement age is 0 which shows that individuals are not delaying retirement in order to be part of the treatment group although retirement age is higher post reform. DC pension value is higher, as is financial wealth but these are both imprecisely estimated. Because of the differences in these variables I add them to the regression model, following

One threat to validity is manipulation of the running variable, retirement year. This is probably quite a threat in this setting as individuals could delay retirement and/or the purchase of an annuity until after the reform. As observed above in Tables 1 and 2, it does not appear like individuals are delaying retirement. However, it is possible that individuals do not buy an annuity at the time of retirement since the law prior to 2014 only required that they access the pot by age 75. They may decide to keep their DC pension untouched and live off other income and assets before accessing it later. Since we do not have data on the exact purchase date of annuities we cannot track whether annuity purchases were delayed because of this. However, there is relatively stable annuity demand before the policy reform. If individuals delayed annuity purchases in expectation of the reform, so they would not have to buy an annuity at all, we would observe declines in purchases before the reform was announced. Likewise, if individuals bought an annuity early in expectation that the end of the compulsory market would cause prices to go up, we would observe a big spike in annuity purchases prior to 2014.

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

Table 2: Covariate Balance

	Pt. est.	SE
Gender	0.130	0.069
RetirementYear	3.518	0.098
InterviewYear	3.075	0.137
YearsSinceRetirement	-0.488	0.092
RetiredAge	0.314	0.448
AgeAtInterview	-0.174	0.455
ExpectedRetiredAge	0.340	0.590
DifferenceAge	0.000	0.565
FinWealth(£000s)	55.245	34.511
DCPension	0.000	0.000
DCValue(£000s)	50.092	210.816
DBPension	0.021	0.069
StatePension	-0.688	0.591
OwnsHouse	0.005	0.043
HouseValue(£000s)	98.249	31.135
ObjectiveLifeExp	0.855	0.477
SubjectiveLifeExp	0.273	1.023

which lifecycle model better fits the consumption response that occurred as a result of the pension reform.

I use a fuzzy regression discontinuity design for which I compare the consumption of individuals who retired after the policy reform to that of people who retired just before the 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 altering their behaviour. As I have argued above, the demographic information in the data suggests 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 show that there was surprise the government put forward the reform, with Money Marketing describing the change as a "bombshell" Selby (2014).

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.

Because of the differences in financial characteristics between the groups, I add controls for financial wealth, housing wealth, whether an individual owns their own home, their gender and the size of their state pension. The following regression equation is used.

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

Where $Cons_{it}$ is one of five different consumption variables and X_{it} is a set of controls.

Table 3 shows the results of this specification on the various consumption indicators. Column 1 has total monthly consumption on the left hand side of the regression equation. We can see that being in the treatment group is associated with £74 more a week in spending overall across all categories of expenditure. This is not statistically significant using robust standard errors. Being further into retirement at the time of interview is associated with higher total 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 inside the house does not increase as a result of the policy reform but food consumed away from the house does increase. A shock to income, caused by no longer needing to annuitise, may cause spending on luxury goods to increase and for spending on their substitutes, like food in the house relative to food away from home, to decrease. This income effect may be driving the results we observe in Table 3 since food consumption outside the home increases as does expenditure on clothing – seen in column 5.

One concern is that the group who retired after 2014 are just generally different to those who retired before and perhaps consume more outside the home anyway. The financial characteristic data presented in 1 would support this hypothesis as it shows all retirees are richer post reform. To test for these cohort effects, I run a difference in difference regression to complement the regression discontinuity just shown. I add individuals who have a DB pension and those with no private pension into the model and interact the policy change with dummies for having different types of pension. Specifically, I run:

$$Cons_{it} = \gamma X_{it} + \beta_1 PostReform_{it} + \beta_2 PostReform * DC_{it} + \beta_3 PostReform * DB_{it} + \epsilon$$

This makes the coefficient of interest β_2, which shows us the difference in the change in consumption between the DC-only group and the base group that has neither a DB or DC pension. Since rules for DB pensions did not change under the pensions freedom act, those with a DB pension or no pension can be seen as a natural counterfactual group to judge the consumption of the DC group against. Likewise, group with no private pension are unaffected by the reform.

The key identifying assumption for difference in difference regressions is the parallel trends assumption. In this context, it means that consumption changes overtime between the DB, DC and no pension group would have been the same were it not for the policy change. Given that there were no other reforms to pension schemes at this time that would have only impacted one of these groups in particular I claim that it holds.

Table 4 shows these results. The post reform variable now tells us that total and food consumption increased but clothing consumption decreased. The interactions at the bottom of the table show us what happened to individuals with a given pension type relative to the reference cohort which has no pension. Those with only a DC pension had an increase in total consumption which was higher than those with a DB pension and higher than those with no pension. Consumption on food decreased slightly for the DC group relative to no pension but the decrease was less than that for the DB group. Expenditure on clothing also increased for the DC group compared to no pension and DB pensions. As above, the only variables that are significant at the 5% level are financial wealth and whether the individual owns their house. However, the fact that using a difference in difference setup also gives us similarly sized estimates is encouraging and validates the regression discontinuity approach.

We can also test whether treatment intensity is correlated with larger increases in spending. Those who have more money in a DC pension, and those with more financial wealth overall, would be impacted by the policy to a greater extent than those with smaller pensions, since they would be forced to annuitise a larger amount. So, I interact the policy with financial wealth and DC wealth. As in Table 3, this regression only uses those individuals who have a DC pension.

To be precise, I run:

$$Cons_{it} = \gamma X_{it} + \beta PostReform_{it} * DCValue_{it} + \epsilon_{it}$$

Table 3: DC Only

	TotalConsump		FoodConsump		FoodConsumpIn		FoodConsumpOut		ClothingConsump	
(Intercept)	933.927	(586.819)	331.229	(376.469)	51.887	(71.958)	104.379	(135.980)	50.095	(224.179)
PostReform	36.461	(55.300)	−4.412	(38.906)	−2.842	(7.727)	9.411	(13.771)	26.601	(25.745)
RetiredAge	−1.064	(9.175)	0.468	(5.951)	0.270	(1.144)	−0.695	(2.091)	−0.335	(3.745)
FinWealth(£000s)	0.249	(0.099)	0.142	(0.066)	0.006	(0.013)	0.110	(0.035)	−0.014	(0.055)
Gender	−48.956	(54.435)	−33.161	(35.394)	−7.945	(6.825)	0.641	(13.415)	7.873	(24.513)
DCValue(£000s)	−0.014	(0.010)	0.005	(0.014)	0.002	(0.002)	−0.004	(0.004)	−0.003	(0.003)
YearsSinceRetirement	17.207	(39.322)	−5.748	(23.936)	−0.295	(4.612)	−5.315	(7.847)	2.265	(15.124)
OwnsHouse	−89.665	(88.919)	117.383	(48.154)	24.588	(9.320)	11.256	(20.655)	77.057	(16.464)
StatePension	−9.936	(8.541)	−4.981	(5.528)	−1.097	(1.107)	−0.012	(1.790)	−3.290	(4.296)
Num.Obs.	208		205		205		208		208	
R2	0.047		0.060		0.050		0.091		0.036	
R2 Adj.	0.008		0.022		0.011		0.055		−0.003	
AIC	3057.7		2837.6		2168.8		2446.7		2735.0	
BIC	3091.1		2870.8		2202.0		2480.0		2768.4	
Log.Lik.	−1518.871		−1408.788		−1074.394		−1213.334		−1357.523	
RMSE	359.00		233.50		45.70		82.63		165.28	
Std.Errors	HC3		HC3		HC3		HC3		HC3	

Table 4: All individuals with interaction

	TotalConsump	FoodConsump	FoodConsumpIn	FoodConsumpOut	ClothingConsump
(Intercept)	579.577 (243.317)	354.694 (149.347)	73.889 (29.662)	35.524 (53.120)	123.304 (66.782)
PostReform	95.284 (45.887)	14.554 (28.679)	−1.433 (5.683)	20.816 (8.903)	−0.927 (14.105)
DCPension	49.070 (34.029)	29.780 (22.514)	3.270 (4.530)	14.810 (7.425)	−2.930 (10.399)
DBPension	91.877 (28.544)	18.263 (18.162)	0.203 (3.692)	17.584 (5.677)	23.123 (10.171)
RetiredAge	2.426 (3.876)	−0.475 (2.428)	−0.106 (0.482)	−0.040 (0.841)	−1.529 (1.058)
FinWealth(£000s)	0.166 (0.066)	0.073 (0.038)	−0.002 (0.006)	0.079 (0.018)	0.017 (0.021)
Gender	−18.178 (25.573)	−18.902 (15.135)	−4.631 (3.026)	1.138 (5.091)	0.596 (9.155)
DCValue(£000s)	−0.012 (0.007)	0.004 (0.012)	0.002 (0.002)	−0.003 (0.004)	−0.004 (0.003)
YearsSinceRetirement	37.759 (18.649)	−9.921 (10.879)	−2.125 (2.106)	−0.990 (3.686)	6.843 (6.835)
OwnsHouse	−89.951 (36.898)	111.079 (18.860)	20.631 (3.860)	21.502 (6.623)	43.088 (9.516)
StatePension	−5.951 (3.933)	−2.951 (2.799)	−0.447 (0.563)	−0.975 (0.799)	0.673 (1.577)
PostReform:DCPension	10.810 (63.408)	−5.036 (40.318)	−0.635 (7.736)	−1.427 (14.718)	36.586 (31.925)
PostReform:DBPension	−138.614 (53.735)	−25.662 (32.791)	−2.118 (6.416)	−16.402 (11.582)	−14.759 (21.472)
Num.Obs.	929	920	921	926	929
R2	0.039	0.049	0.030	0.102	0.029
R2 Adj.	0.027	0.036	0.018	0.091	0.017
AIC	13 603.3	12 622.8	9669.3	10 650.0	11 785.3
BIC	13 671.0	12 690.3	9736.8	10 717.6	11 853.0
Log.Lik.	−6787.670	−6297.391	−4820.635	−5311.000	−5878.642
RMSE	360.50	227.25	45.39	74.92	135.50
Std.Errors	HC3	HC3	HC3	HC3	HC3

Table 5: DC Pension Size interaction

	TotalConsump		FoodConsump		FoodConsumpIn		FoodConsumpOut		ClothingConsump	
(Intercept)	933.480	(587.440)	332.103	(376.369)	52.065	(71.854)	104.467	(136.087)	50.218	(223.994)
PostReform	34.354	(56.785)	−0.153	(39.774)	−1.974	(7.885)	9.828	(14.182)	27.181	(26.798)
RetiredAge	−1.053	(9.187)	0.449	(5.945)	0.266	(1.141)	−0.697	(2.093)	−0.338	(3.740)
FinWealth(£000s)	0.250	(0.099)	0.140	(0.066)	0.005	(0.013)	0.109	(0.035)	−0.014	(0.056)
Gender	−49.495	(54.672)	−31.847	(35.608)	−7.677	(6.869)	0.748	(13.477)	8.021	(24.741)
DCValue(£000s)	−0.020	(0.023)	0.016	(0.038)	0.004	(0.008)	−0.003	(0.005)	−0.002	(0.009)
YearsSinceRetirement	17.917	(39.671)	−7.264	(24.534)	−0.604	(4.745)	−5.456	(7.920)	2.070	(15.515)
OwnsHouse	−89.060	(88.887)	116.154	(48.223)	24.338	(9.336)	11.136	(20.678)	76.890	(16.259)
StatePension	−9.903	(8.574)	−5.061	(5.539)	−1.113	(1.109)	−0.018	(1.803)	−3.299	(4.319)
PostReform:DCValue(£000s)	0.008	(0.038)	−0.016	(0.039)	−0.003	(0.009)	−0.002	(0.031)	−0.002	(0.019)
Num.Obs.	208		205		205		208		208	
R2	0.047		0.063		0.052		0.091		0.036	
R2 Adj.	0.004		0.019		0.009		0.050		−0.008	
AIC	3059.7		2839.1		2170.3		2448.6		2737.0	
BIC	3096.4		2875.6		2206.8		2485.3		2773.7	
Log.Lik.	−1518.847		−1408.547		−1074.133		−1213.316		−1357.514	
RMSE	358.96		233.23		45.64		82.62		165.27	
Std.Errors	HC3		HC3		HC3		HC3		HC3	

Table 6: DC Financial Wealth interaction

	TotalConsump		FoodConsump		FoodConsumpIn		FoodConsumpOut		ClothingConsump	
(Intercept)	792.453	(658.026)	157.868	(412.133)	56.231	(68.529)	−89.273	(230.920)	110.932	(206.002)
PostReform	77.996	(75.305)	9.980	(48.402)	−2.599	(8.952)	20.981	(20.937)	30.043	(40.234)
RetiredAge	2.134	(10.664)	4.024	(6.737)	0.201	(1.097)	3.187	(3.900)	−1.370	(3.397)
FinWealth(£000s)	0.322	(0.154)	0.164	(0.140)	0.009	(0.018)	0.117	(0.069)	0.059	(0.102)
Gender	−31.169	(58.520)	−47.768	(35.468)	−8.490	(6.543)	−11.772	(15.953)	8.354	(25.126)
YearsSinceRetirement	0.541	(44.781)	−23.842	(24.362)	−2.771	(4.670)	−12.460	(9.195)	−11.846	(20.035)
OwnsHouse	−139.190	(107.632)	102.073	(53.269)	25.433	(8.712)	−8.030	(30.091)	74.816	(15.601)
StatePension	−15.442	(9.020)	−7.971	(6.146)	−0.775	(1.089)	−4.373	(3.322)	−0.596	(4.659)
PostReform:FinWealth(£000s)	0.098	(0.377)	−0.025	(0.175)	−0.003	(0.028)	−0.002	(0.103)	−0.116	(0.170)
Num.Obs.	222		219		219		222		222	
R2	0.077		0.072		0.048		0.088		0.030	
R2 Adj.	0.042		0.037		0.012		0.054		−0.007	
AIC	3329.2		3061.4		2313.1		2776.8		2936.1	
BIC	3363.2		3095.3		2347.0		2810.8		2970.1	
Log.Lik.	−1654.605		−1520.681		−1146.532		−1378.376		−1458.053	
RMSE	417.48		250.84		45.44		120.30		172.24	
Std.Errors	HC3		HC3		HC3		HC3		HC3	

Table 5 shows the results. Surprisingly, a larger DC pension pot is not associated with a greater increase in consumption. And although the reform is again associated with an increase in consumption, especially for food out of the house and clothing, this effect is decreasing with the size of the pension pot.

The DC pension pot size variable comes from work done by the IFS. The data after wave 5 has not been released so for individuals later than this I have no DC wealth variable. For Table 5, pension wealth from the last available year for an individual was given a real return of 3% and compounded until year of interview. Given that this is an imperfect measure, I also run the regression with financial wealth interacted with the treatment variable.

Table 6 contains these results and shows a similar pattern to Table 5. The reform is associated with an increase in consumption, but more financial wealth decreases the effect rather than making it stronger. This could be because those with higher levels of financial wealth have more assets in other savings apart from retirement savings Cribb and Karjalainen (2023) and therefore the DC pot is a smaller proportion of overall assets meaning the policy change did not affect them as much.

In conclusion, the results in the tables above show that in the basic regression discontinuity setup there is an impact of the policy reform on consumption, and this effect is stronger for consumption goods we would associate with a large increase in income. However, this is imprecisely estimated, and when we use a difference in difference identification method this effect disappears. Moreover, when we interact with a proxy for treatment strength (financial wealth or pension size) the effect is smaller the stronger the treatment.

Theoretically, a null change in consumption is evidence for a bequest motive explaining a lack of annuitisation rather than pessimistic life expectancies being the cause. In the next section I solve and simulate a lifecycle model for individuals in the ELSA dataset. I find that the bequest motive most closely matches the patterns observed in the empirical models above.

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 in similar regressions to the ones above.

In recursive form, the problem that retirees face is as follows. Every period retirees solve:

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

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, V_t is value in period t, p_t is probability of death in period t and $B()$ is a bequest function. Income comes from the state pension and purchased annuities. $\beta = 0.97$ is an individuals discount rate and $r = 1/0.97$ is the return on savings. I enter t directly into the value function as a state variable to make it clear that value is also conditional on age – through the death probability and the total number of periods left until terminal age.

As is common in the literature Lockwood (2012), I use a constant relative risk aversion utility function.

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

Where $\sigma = 2.5$.

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

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

Where a_{t+1} is the amount left at death. c_0 is the amount of consumption below which individuals will not leave bequests. If $c_0 > 0$ then bequests are a luxury good and the wealthier the individual the more they will bequest. m is the marginal propensity to bequeath after consuming at least c_0 and a higher value of m means that individuals will leave a greater share of wealth to their heirs. I pick values of $m = 0.95$ and $c_0 = 20,000$ since these generate low rates of annuitisation, for comparison, Lockwood (2018) finds c_0 is in the range of $\$12,000$ to $\$30,000$ and m is between 0.93 and 0.96 in a variety of models.

To solve this problem, I discretise the state space. I create a grid from £500 to £50,000 incrementing by £500 for income and £1,000 to £500,000 incrementing by £1,000 for financial assets. I solve the retirees problem using backward induction. At age 110 there is certainty of death so any leftover assets are 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 individual's final period problem, choosing assets next period (i.e. those to bequest) and how much to consume. This will be all assets for individuals with no bequest motive or assets below £20,000 (c_0).

Using the optimal policy function in the last period, which is assets next period that maximise the utility function and the value function this period given all the potential income and asset states, I calculate the value of the last period. 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 problem for each new retiree in the dataset 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 roughly fit the real annuity rates seen in the data.

In retiree's first year of retirement I somtimes annuitise some of their wealth. In practical terms, this is moving down the asset grid but up the permanent income grid and seeing if the value of being in that position is better than where the individual is currently. To assess 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:

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

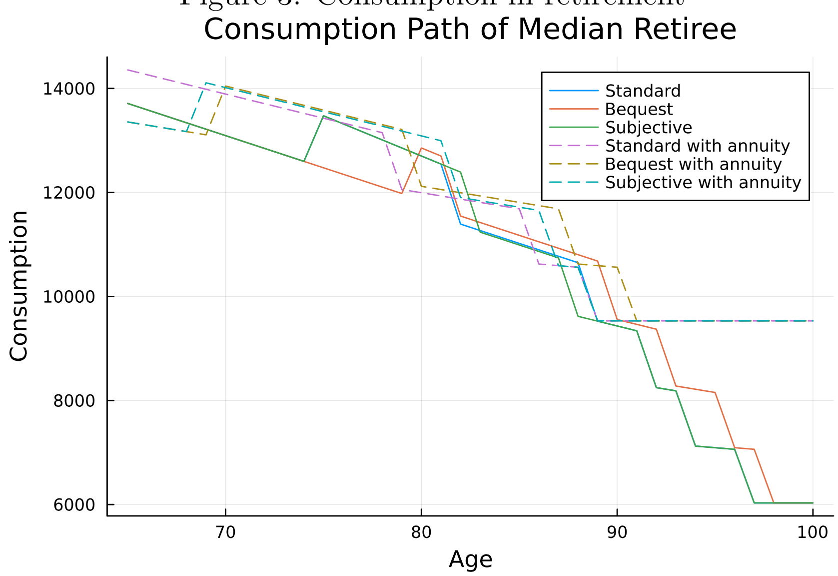
Where C is the one-off payment, δ is the 'money's worth' of an annuity and $p_{t|Retage}$ is the probability of death at age t conditional on being age $Retage$. So individuals can move C on the asset grid for gaining Ann on the income grid for the rest of their lives. The 'money's worth' of an annuity is the ratio of expected present discounted value to the price of an annuity that an individual can purchase. Generally, for annuities, they have been found to be between 0.8 and 0.9 for the population as a whole in the UK, Finkelstein and Poterba (2002) Finkelstein and Poterba (2004).

4 Lifecycle Results

Having found optimal policy functions and value functions I can now simulate the change in consumption given different rates of annuitisation versus no annuitisation. There are multiple benefits to building a model of individual's decisions. Firstly, we can directly compare what a given individual would have consumed with what they actually consumed, conditional on our model being correct. In other words, we have the counterfactual world in which individuals were not forced to annuitise. Secondly, I can simulate the impact of different policy changes on the consumption, savings and bequest behaviour. For example, I could change the proportion of wealth that will be annuitised and see the corresponding changes in consumption indicators for all individuals.

I now plot the retirement path of consumption for a median individual in the ELSA data set. I plot consumption with different proportions of starting wealth annuitised and the different lifecycle model types.

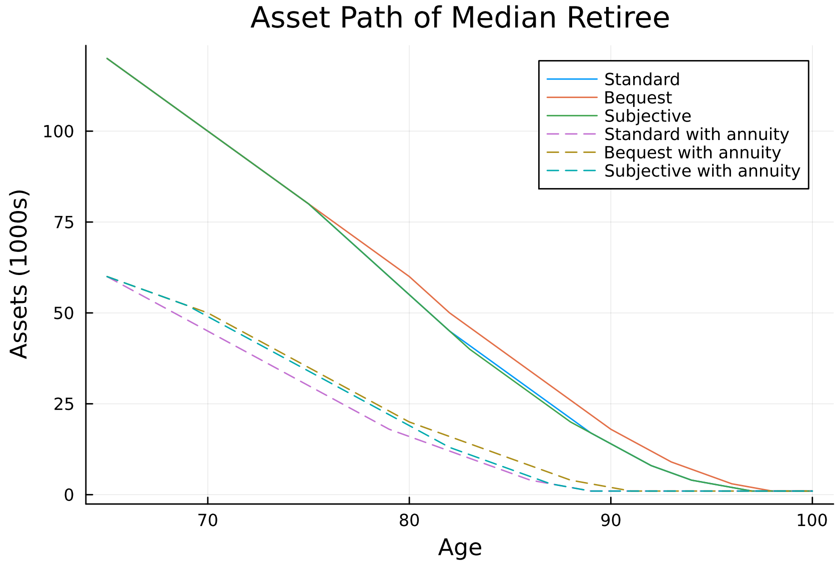
Figure 3: Consumption in retirement



Figures 3 and 4 show the retirement path of consumption and assets for a median retiree. This hypothetical woman has £120,000 of assets at age 65 when they retired in 2012 with a state pension income of £6000. The dashed lines show consumption and assets with an annuity that costs half of their wealth. This buys them £3500 of annuity income, which, given their objective life expectancy is a money's worth of about 90%.

We can see that the asset path with the bequest motive keeps more for longer but still

Figure 4: Assets in retirement



decreases, and by their late 90s they have completely run down their wealth. Interestingly, the asset path with the quickest run down is the standard lifecycle model using objective life expectancies, which points towards this individual being optimistic about their life chances. Also rather surprisingly the asset paths of all three types are similar without annuities. The paths only diverge after age 75 at which point the bequest path stays high and the other paths start to decrease faster. This is contrary to the path with annuities where the standard path diverges from the bequest and subjective paths immediately.

The consumption paths all start at around £14,000 a year. The three models without an annuity start at exactly the same amount and stay that way until the individual reaches her mid seventies – showing that even quite different lifecycle models can generate similar paths. As expected, the consumption path with the bequest motive with an annuity is lower at the start of retirement than the bequest path without an annuity as individuals seek to build their savings back up. But it is also lower for the subjective life expectancy case, again pointing toward this individual being optimistic. However, the subjective consumption line rises at a younger age than the line with bequests, showing that the models align with the prediction that subjective lifecycle agents consume more in early retirement compared to the other lifecycle models.

It is worth noting that the period of interest of this study is early retirement and although differences across the lifecycle are not large, there are significant differences at the start of

Table 7: Model consumption predictions

	Mean		Non Missing		Sd	
	Control	Treat	Control	Treat	Control	Treat
Bequest	891.3230	1041.2196	98	49	553.5802	540.8520
Standard	918.5339	1068.4305	98	49	602.9341	573.0909
Subjective	1018.3042	1144.9085	98	49	720.9637	597.3735
Total Monthly (ELSA)	763.5413	887.8606	98	49	367.2683	538.9208

retirement. This shows that different lifecycle models will produce substantive differences in predictions, so knowing which model is correct is important for policy.

I first round an ELSA individual's financial wealth to the nearest point on the discrete asset grid, and do likewise for an individual's state pension income. I then take the treatment group and evaluate their consumption in the year of interview with an annuity, given that they annuitised 50% of their financial wealth in their retirement year. I also evaluate consumption without annuitisation. The treatment group did not need to annuitise their wealth so I use their predicted consumption from the lifecycle models with their starting values of assets and pension income taken from their values in the ELSA dataset. To be clear, the only individuals for whom I annuitise wealth are those with DC pension pots who retired before 2014.

Because I discretised the state space, annuity prices are rounded down to the nearest income grid point. I set the money's worth of annuities to 0.9 when calculating annuity prices but because I round down to the nearest income grid point the real money's worth an individual receives is lower. I assume that those who have a DC pension have half of their financial wealth in it since this matches roughly what is seen in the summary statistics, so, for the untreated group – those who retired pre-reform – I annuitise half of wealth. However, since some individuals cannot buy a £500 annuity, which relates to one grid point, with half of their financial wealth I only annuitise when an individual has financial assets large enough to cross this threshold. I do not let these individuals, with low assets, annuitise, setting consumption with and without an annuity to the same amount.

Table 7 shows the mean of consumption that each lifecycle model predicts for the treated and control groups as well as the original mean of consumption from the ELSA data for the individuals with non-missing values. The sample size of those with a DC pension is greatly reduced. This is mainly because not everyone in the ELSA data answers the life expectancy questions and of those who do answer some give answers that we cannot use for reasons listed in the data section.

We can see the means for the control group are higher than the treated mean for all models but there is significant difference between the original level of consumption in the control group. The bequest and standard model both predict lower consumption than the subjective model which is not surprising given the subjective lifecycle individuals generally think their lives will be shorter and therefore can consume more early in retirement. Likewise, it makes sense the bequest model is lower than both other models since there is extra utility to be gained from saving so that one can bequest to their heirs.

I now run the empirical models from above on this simulated data. This lets us see which lifecycle model gives us the closest match to the coefficients seen in the real data. We can therefore predict how other policy changes will impact behaviour as well as predict the full path for assets and consumption later into retirement. Matching a full model with method of simulated moments, though possible using the entire ELSA data like **cite paper eric sent me**, does not allow us to use incorporate policy changes into model.

Table 8: Simulated standard lifecycle models

	DCOnly	AllDataDCInteraction	DCOnlyPensionInt	DCOnyFinancialInt
(Intercept)	−681.172	−648.121	−681.816	−588.159
PostReform	2.841	−4.678	0.558	30.651
RetiredAge	10.688	10.332	10.714	9.088
FinancialWealth (thousands)	4.433	4.316	4.435	4.512
Gender	13.066	23.299	12.707	14.345
DCValue (thousands)	0.000	0.001	−0.006	
YearsSinceRetirement	−6.223	−0.621	−6.492	−7.268
OwnsHouse	14.666	21.488	15.294	13.215
StatePension	89.059	89.236	89.086	89.271
DCPension		−15.382		
DBPension		1.522		
PostReform:DCPension		17.764		
PostReform:DBPension		−11.353		
PostReform:DCValue (thousands)			0.007	
PostReform:FinancialWealth (thousands)				−0.219
Num.Obs.	139	584	139	147
R2	0.995	0.993	0.995	0.995
R2 Adj.	0.994	0.993	0.994	0.995
AIC	1462.6	6160.6	1463.1	1531.0
BIC	1492.0	6221.8	1495.4	1560.9
Log.Lik.	−721.311	−3066.315	−720.560	−755.478
RMSE	43.40	46.14	43.16	41.28
Std.Errors	HC3	HC3	HC3	HC3

Table 9: Simulated bequest lifecycle models

	DCOnly	AllDataDCInteraction	DCOnlyPensionInt	DCOnyFinancialInt
(Intercept)	−447.672	−543.511	−448.371	−439.946
PostReform	16.687	−10.850	14.207	24.811
RetiredAge	7.577	9.155	7.605	7.446
FinancialWealth (thousands)	4.076	4.071	4.078	4.103
Gender	13.731	19.651	13.342	13.384
DCValue (thousands)	0.001	0.001	−0.005	
YearsSinceRetirement	−1.225	−0.888	−1.517	−2.273
OwnsHouse	5.064	17.853	5.746	3.839
StatePension	84.422	84.994	84.451	84.404
DCPension		−20.629		
DBPension		0.556		
PostReform:DCPension		25.529		
PostReform:DBPension		2.655		
PostReform:DCValue (thousands)			0.008	
PostReform:FinancialWealth (thousands)				−0.061
Num.Obs.	139	584	139	147
R2	0.996	0.995	0.996	0.996
R2 Adj.	0.995	0.995	0.995	0.995
AIC	1420.0	5938.7	1419.6	1496.3
BIC	1449.4	5999.9	1451.9	1526.2
Log.Lik.	−700.021	−2955.338	−698.814	−738.142
RMSE	37.23	38.15	36.91	36.69
Std.Errors	HC3	HC3	HC3	HC3

Table 10: Simulated subjective lifecycle models

	DCOnly	AllDataDCInteraction	DCOnlyPensionInt	DCOnyFinancialInt
(Intercept)	−1026.675	−779.754	−1025.583	−1031.885
PostReform	−62.876	−14.694	−59.004	63.140
RetiredAge	16.559	12.666	16.516	16.386
FinancialWealth (thousands)	5.054	4.749	5.050	5.433
Gender	−62.495	−30.426	−61.888	−52.366
DCValue (thousands)	0.002	0.008	0.012	
YearsSinceRetirement	−33.070	1.922	−32.613	−42.024
OwnsHouse	66.452	44.938	65.386	51.098
StatePension	92.846	92.993	92.800	91.539
DCPension		7.564		
DBPension		−13.519		
PostReform:DCPension		−30.893		
PostReform:DBPension		16.740		
PostReform:DCValue (thousands)			−0.012	
PostReform:FinancialWealth (thousands)				−0.949
Num.Obs.	139	584	139	147
R2	0.961	0.943	0.961	0.966
R2 Adj.	0.958	0.942	0.958	0.964
AIC	1781.1	7552.2	1782.6	1856.3
BIC	1810.4	7613.4	1814.9	1886.2
Log.Lik.	−880.536	−3762.108	−880.319	−918.173
RMSE	136.44	151.87	136.22	124.85
Std.Errors	HC3	HC3	HC3	HC3

Tables 8, 9 and 10 show the results. Each column in the table shows a different empirical model that was applied to the data in the first part of this paper. The first column just takes those with DC pensions, the second looks at all individuals, whilst the third and fourth have interactions with financial wealth and DC pension wealth.

Comparing the DC-only column across tables we can see that simulated bequest model gives us the highest increase in consumption as a result of the reform. This could be because this type of individual was previously saving out of the annuity income to regain assets, so when they do not need to buy an annuity anymore their consumption actually increases. Surprisingly, the predictions from the lifecycle model using subjective life expectancies actually has a decreasing coefficient on the reform even though on average for a given individual consumption should increase as shown by the simple comparison in means. However, this difference could be the result of the post-reform group having higher subjective life expectancies, and therefore their consumption would be lower than the control group.

The lifecycle model that is closest to the empirical models shown in Table 3 is the bequest model which gives an increase of 17 in monthly consumption. However, this coefficient is just under half of the change estimated in Table 3 and reflects only a 0.6% rise in consumption after the reform.

In the second column, the coefficient of interest is the DC pension interaction with the treatment variable since I use the difference in difference setup again. The bequest model has a coefficient of 25.6, the standard model one of 17.7 and the standard model with subjective life expectancies has one of -30.9. These coefficients are higher than the coefficient seen in Table 4 with the predictions from the standard model matching the coefficient in the empirical model best. The subjective model again has the opposite sign to the one seen in the empirical model.

The interaction models in columns 3 and 4 both have correct signs for the main reform effect in the standard and bequest models, although in both the interaction with financial wealth has a negative coefficient showing that the increase in consumption caused by the reform was progressively lower for those who would have had to annuitise more wealth. In the subjective model table the signs are again wrong apart from for the main treatment effect in the financial interaction column. The lifecycle model that appears closest to the empirical results is again the bequest model, which matches the signs from Tables 5 and 6, but the coefficients are smaller.

Across all regressions, the lifecycle model using subjective life expectancies does not match the change in consumption that is seen when using ELSA data. It is surprising that the consumption response is also very different to the other lifecycle models used. One possible explanation for this could be that the control and treatment groups have quite different sets of objective life expectancies which therefore cause different consumption paths in early retirement. The structure that the Weibull distribution imposes on the transition probabilities could also be causing discontinuities in a given individuals subjective probability of death between two periods, which would impact how they consume across that part of retirement.

The evidence just presented points towards the bequest model being best able to replicate the consumption response in the data. As highlighted above, the benefit of having a theoretical model is that we can trace out future values of consumption for individuals, only needing to know their starting point. So using the bequest solution to the retirement problem, I plot the whole path of average consumption and assets for the ELSA treated cohort. This plot is shown in the figure below.

Also get some plots of consumption in early retirement with and without annuities for the different model types

5 Conclusion

5.1 Rough plan

- Intro
  1. "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/2022/0 freedoms-were-they-really-a-good-idea/
  2. what portion of savings are because of retirement savings?
  3. 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/

  Follow up by changing chat because the parameter estimates for the diff

in diff have changed a bit – DONE but check again when I have gone through it – haven't checked the comparisons

- **Abstract**
- **Talk about covariate balance table? We could just set it for the DC groups.**
- **Add bit about testing just those people who retired when they expected to retire.**
- **Could add consumption and retirement year plot?**
- **Maybe a small discussion of controls for the main regression tables as well**
- Conclusion

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