



ECONOMICS AND FINANCE OF PENSIONS

Lecture 8

ANNUITIES MARKETS

Dr David McCarthy



Today's lecture

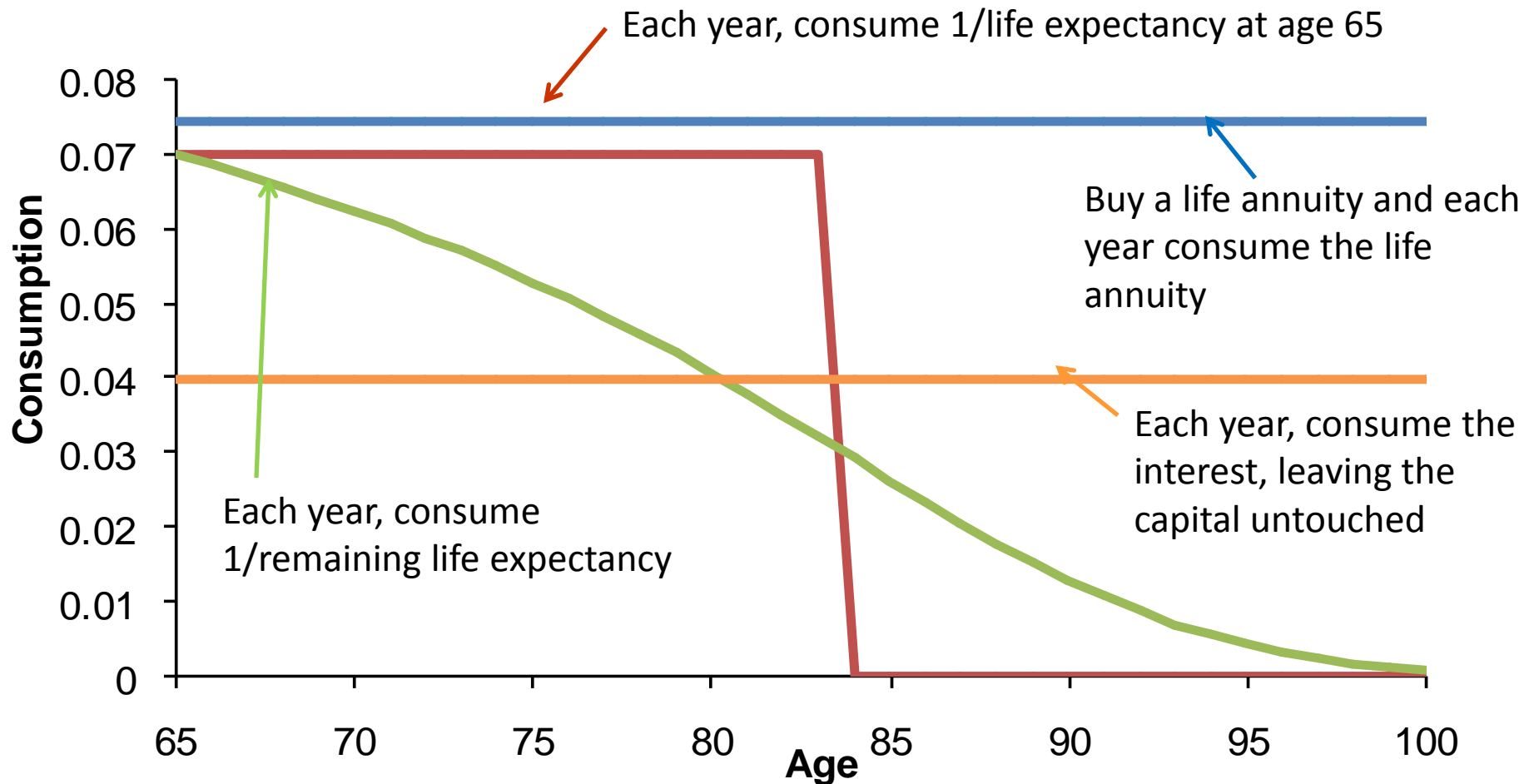
- Why study annuities?
- Annuity demand
 - Theoretical demand for annuities
 - The demand puzzle
 - Asymmetric information
 - Annuity money's worth
- Mandatory annuitisation
- Other decumulation options
- Other factors



Why study annuities?

- People are living longer and longer, so the risk of outliving assets is becoming more serious
- Future retirees will be relying much more on unannuitised wealth (e.g. DC pensions) than on annuitised wealth (e.g. DB or state pensions)
- Annuity markets are un-or-underdeveloped in all but a few countries
- So annuities are a big future opportunity & have the potential to be welfare improving

Alternative consumption paths





Alternative consumption paths

- Each one leaves a different bequest
- Each one exposes the person to a different risk of outliving their savings
- There is a direct trade-off between consumption in retirement and the probability of outliving your assets
 - The higher your consumption, the higher the probability you outlive your assets
 - The lower your consumption, the higher the expected value of unintended bequests
- Life annuities offer a way out of this conundrum

Model of annuity demand

$$\max_{\{c_i, y\}} \sum_{i=0}^m r^i p_i u(c_i)$$

$$w_{i+1} = (w_i - c_i + y)(1 + r)$$

$$w_0 = w - y \ddot{a}_0^r$$

← Annuity income

← Buy annuity at time 0 at an actuarially fair price

- The agent must decide how much annuity to purchase at time 0, and thereafter how much to consume each time period, conditional on receiving the annuity



How do we solve this problem?

- Use backward induction as before, but with the added complication that we don't know how much annuity the individual decided to buy at time 0 when we start solving the problem at the last period
- Therefore we have to use y as a second state variable (so it is now a two state variable problem)
- We write the value function as

$$V_i(w_i, y) = \max_{\{c_j\}} \mathop{\text{a}}^{\circ} \prod_{j=i}^m r^{j-i} \frac{p_j}{p_i} u(c_j)$$



Derive the Euler equation

- We derive the Euler equation exactly as before, so

$$\begin{aligned} V_i(w_i, y) &= \max_{\{c_i\}} u(c_i) + \frac{p_{i+1}}{p_i} r V_{i+1}(w_{i+1}, y) \\ &= \max_{\{c_i\}} u(c_i) + \frac{p_{i+1}}{p_i} r V_{i+1}((w_i - c_i + y)(1 + r), y) \end{aligned}$$

- Take first order condition

$$0 = u'(c_i) - \frac{p_{i+1}}{p_i} r (1 + r) V_{w,i+1}(w_{i+1}, y)$$

- Use the envelope theorem

$$V_{w,i}(w_i, y) = \frac{p_{i+1}}{p_i} r (1 + r) V_{w,i+1}(w_{i+1}, y)$$



Derive the Euler equation

- So the following relationship holds

$$u'(c_i) = V_{w,i}(w_i, y)$$

- And

$$u'(c_{i+1}) = V_{w,i+1}(w_{i+1}, y)$$

- So:

$$u'(c_i) = \frac{p_{i+1}}{p_i} r(1+r)u'(c_{i+1})$$

- We can solve this recursively, using backward induction remembering that at each time period, consumption is a function of wealth *and* annuity income



Solving the optimal annuitisation

- After performing this operation we will eventually have the function:

$$V_0(w_0, y) = \max_{\{c_j\}} \mathring{\mathbf{a}} \sum_{j=0}^m r^j p_j u(c_j)$$

- Now, we need to derive the value function which is only a function of wealth:

$$V(w) = \max_y V_0(w - \ddot{a}_0^r y, y)$$



First order conditions

- Take first order conditions

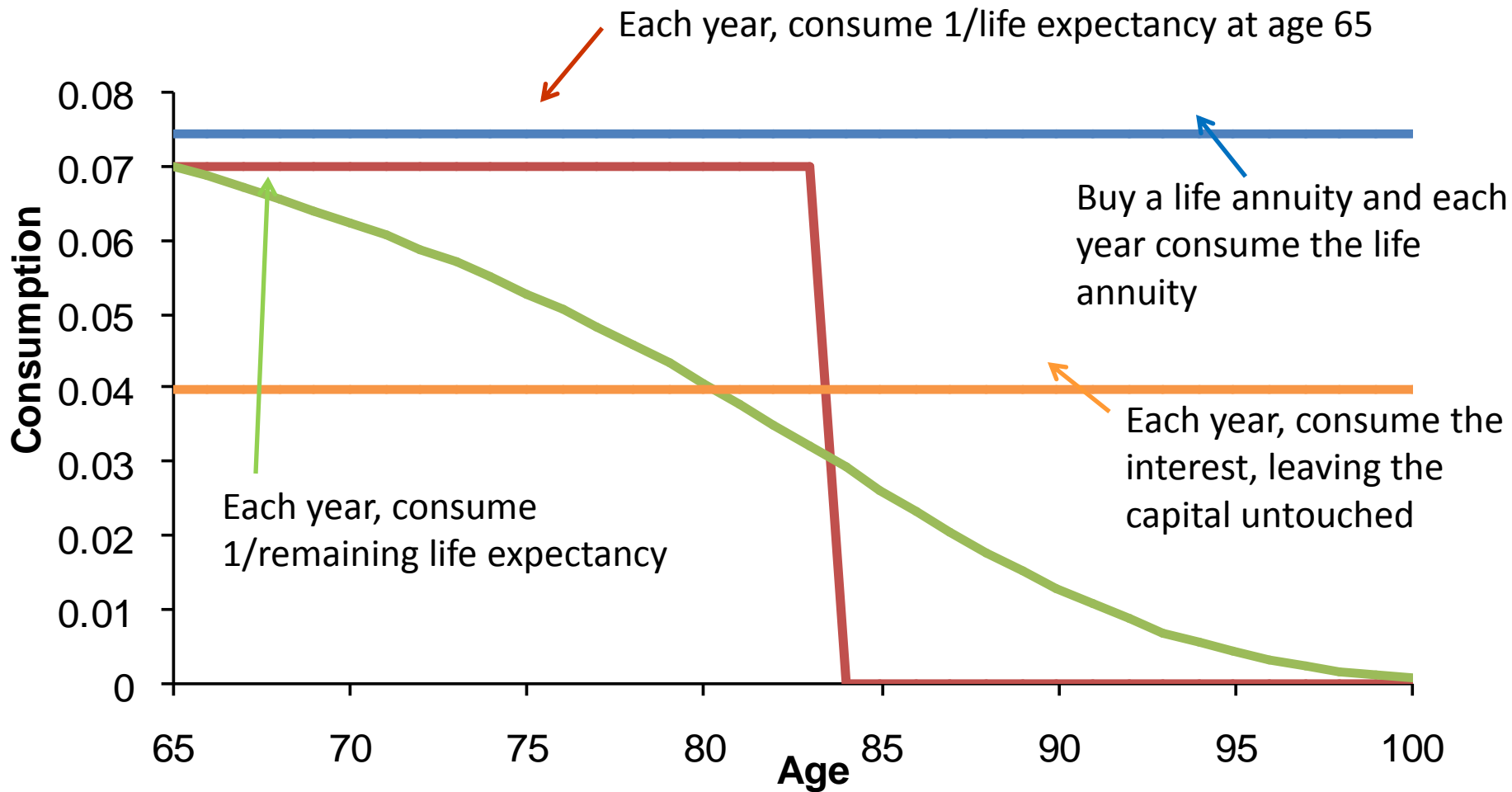
$$0 = - \ddot{a}_0^r V_{w,0}(w - \ddot{a}_0^r y, y) + V_{y,0}(w - \ddot{a}_0^r y, y)$$

$$\ddot{a}_0^r V_{w,0}(w - \ddot{a}_0^r y, y) = V_{y,0}(w - \ddot{a}_0^r y, y)$$

$$\ddot{a}_0^r u'(c_0(w - \ddot{a}_0^r y, y)) = V_{y,0}(w - \ddot{a}_0^r y, y)$$

- This equation gives the optimum level of annuitisation at time 0 for this agent
- We don't have any bequest motives in the model (how would we include these?)

Alternative consumption paths





Yaari (1965)

- Was the first to discover the classic result on demand for life annuities
- If annuities are fairly priced, then individuals should be willing to purchase them with all their money
 - Annuities eliminate unintended bequests
 - Annuities pool longevity risk
 - These two points allow a much higher level of lifetime consumption, with less risk, than individuals could obtain without life annuities



What do we observe in practice?

- In virtually every country, individuals only purchase life annuities if they are forced to do so
- Very few countries have an active, voluntary, annuity market (UK almost alone in this)
- In the UK, the voluntary annuity market is very small relative to the compulsory annuity market (in 2004, $SP(\text{Comp}) \approx 7\text{bn}$; $SP(\text{Vol}) \approx 60\text{mn}$ or around 1% of the size)
- In the US, there is no market in compulsory annuities because annuitisation is not compulsory, and hence the market in life annuities generally is very small (variable annuities are not, in general, life annuities)



Are the economists wrong AGAIN?

- The result of Yaari (1965) was strikingly different from observed reality
- It got economists thinking (for 40 years now)
- Why would individuals NOT want to purchase annuities?



Disadvantages of investing in annuities

- Credit risk of insurer (?)
 - Not really important in developed countries
- Bequest motives (?)
 - Annuities protect bequests as well
- Loss of equity risk premium
 - Individuals optimally invest some assets in equities even in retirement
- Other consumption shocks (e.g. health)
 - Particularly important in the US, but possibly also here



Disadvantages of annuities

- Over-annuitisation
 - Individuals already have a substantial amount of wealth in the form of annuities
 - State pensions
 - Private DB and DC pensions in the UK
 - Private DB pensions elsewhere
- Ability to self-annuitise
 - Families already diversify some mortality risk between themselves
- Annuities may be expensive



Annuity equivalent wealth

- To estimate how different factors affect theoretical demand for annuities, we can estimate the ratio of unannuitised wealth to annuitised wealth which gives individuals the same level of lifetime satisfaction

- First we solve the equation $V_0(w, 0) = V_0(0, y)$

- And then examine the ratio $AEW = \frac{w}{a_0 y}$

- If annuities are in demand, then $AEW > 1$



Assumptions in deriving AEW

- We can make any assumptions we like in estimating the value functions we use to calculate AEW – for instance, including spouses, access to equity markets, bequest motives and state pension wealth
- We just need to make our basic life-cycle model more complicated and be careful to perform the calculations correctly



AEW: Brown and Poterba (2000)

- Jeffrey Brown is an economist who has done a lot of work on annuities (at University of Illinois, Urbana-Champaign)
- Jim Poterba we have met before (MIT)
- They calculated AEW for single and married individual with different levels of bequest motives and different lifetime circumstances
- Results still indicate substantial demand for annuities, but marriage reduces demand, pre-annuitisation is significant, and risk aversion increases demand

	0% of wealth pre-annuitized	
	$\beta = 1$	$\beta = 2$
Single	1.475	1.597
Married	1.158	1.205

	50% of wealth pre-annuitized	
	$\beta = 1$	$\beta = 2$
Single	1.297	1.383
Married	1.099	1.138



Brown (2001)

- He used a life-cycle model to calculate the AEW of 869 individuals in the US Health and Retirement Study
- First he regressed the calculated values of AEW on the individual characteristics to see how important they are

Dependent variable: AEW (mean 1.166)	Regression coefficient	Standard error
Married	-0.2260	0.0041
Risk aversion ^a	0.0152	0.0009
% Pre-annuitized	-0.1419	0.0073
Retirement age	0.0091	0.0004
Birth year		0.0003
Female	-0.001	0.0031
Constant	-3.987	0.7251
R-squared	0.8380	
N	869	



Brown (2001)

- The HRS asked whether individuals intended to annuitise their DC pensions at retirement
- He regressed their answers on the level of their AEW, and obtained the following

Dependent variable: Intended annuity choice (mean 0.48)	Probit coefficient	Standard error
AEW	1.018	0.2248
Myopic ^a	0.2838	0.0808
Myopic ^a AEW	-1.808	0.4694
Wealth (\$100,000)	-0.0070	0.0032
Bequest very important ^a	-0.0071	0.0505
Bequest somewhat important ^a	-0.0358	-0.0397
Health dummies	Y	
Education dummies	Y	
Industry dummies	Y	
Occupation dummies	Y	
Log likelihood	-555.8	
N	869	



Brown (2001)

- AEW only marginally important
- Myopia reduces the level of intended annuitisation
- Bequest motives insignificant
- Children unimportant
- Health status is important (not shown in regression table)
 - People self-reporting poor health were 30% less likely to wish to annuitise than people self-reporting good health



Inkmann et al (2007)

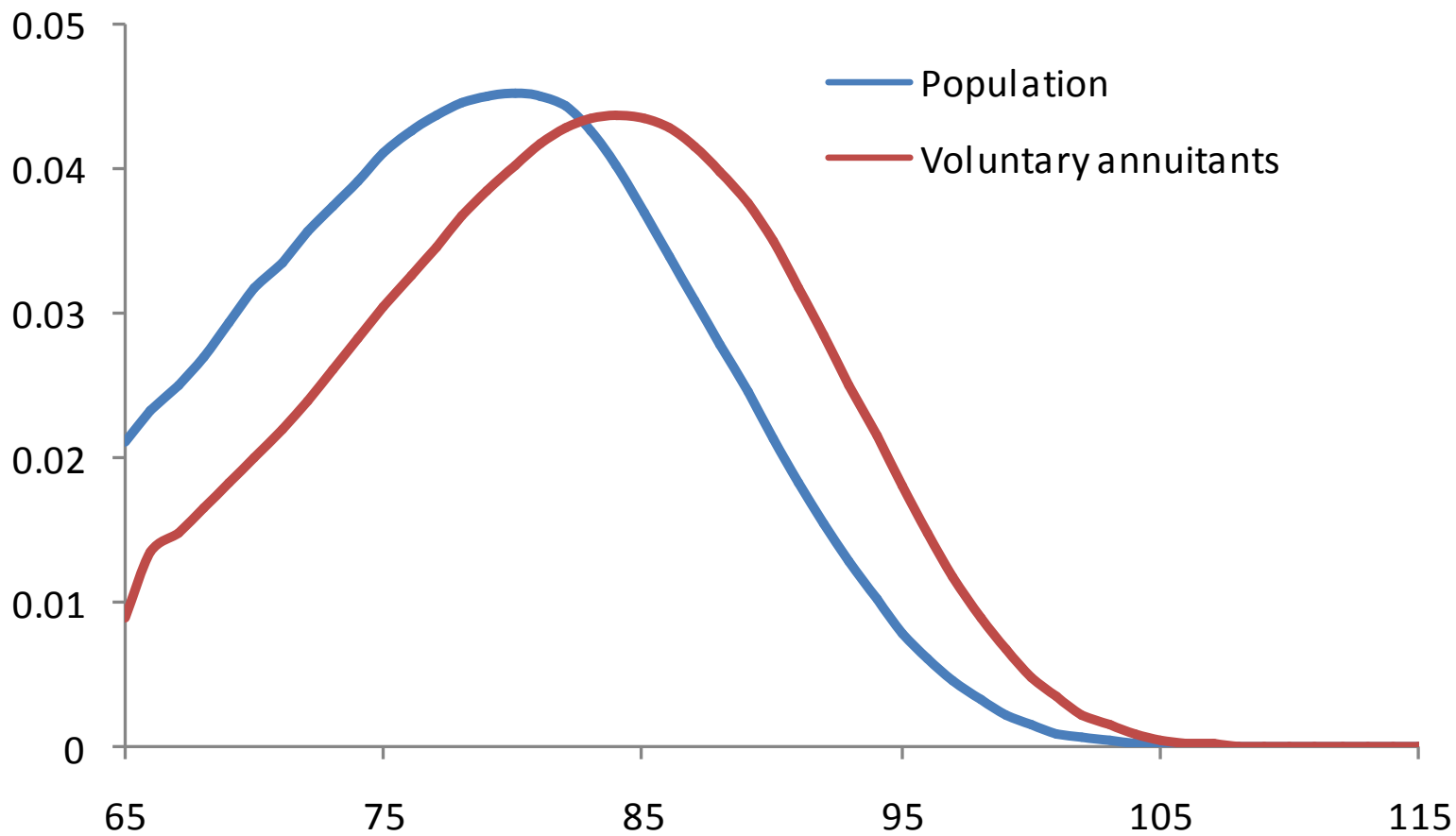
- Joachim Inkmann (ex LSE) is at Tilburg University, Paula Lopes and Alexander Michaelides, both of LSE
- The paper documents the low voluntary annuity demand in the UK, and,
- Explains it as a function of high returns on stock market investment, high pre-annuitised wealth, life expectancy and bequest motives
- Paper uses data from England (ELSA, very similar to HRS for the US)



Importance of health status

- Brown found that self-reported health status was a very important predictor of annuitisation patterns
 - Good self-reported health raises the probability of voluntary annuitisation
- This raises some very important questions about annuity market equilibrium, because health is correlated with life expectancy which is correlated with the correct price of an annuity
 - Our economic toolbox: adverse selection!

Distribution of age at death



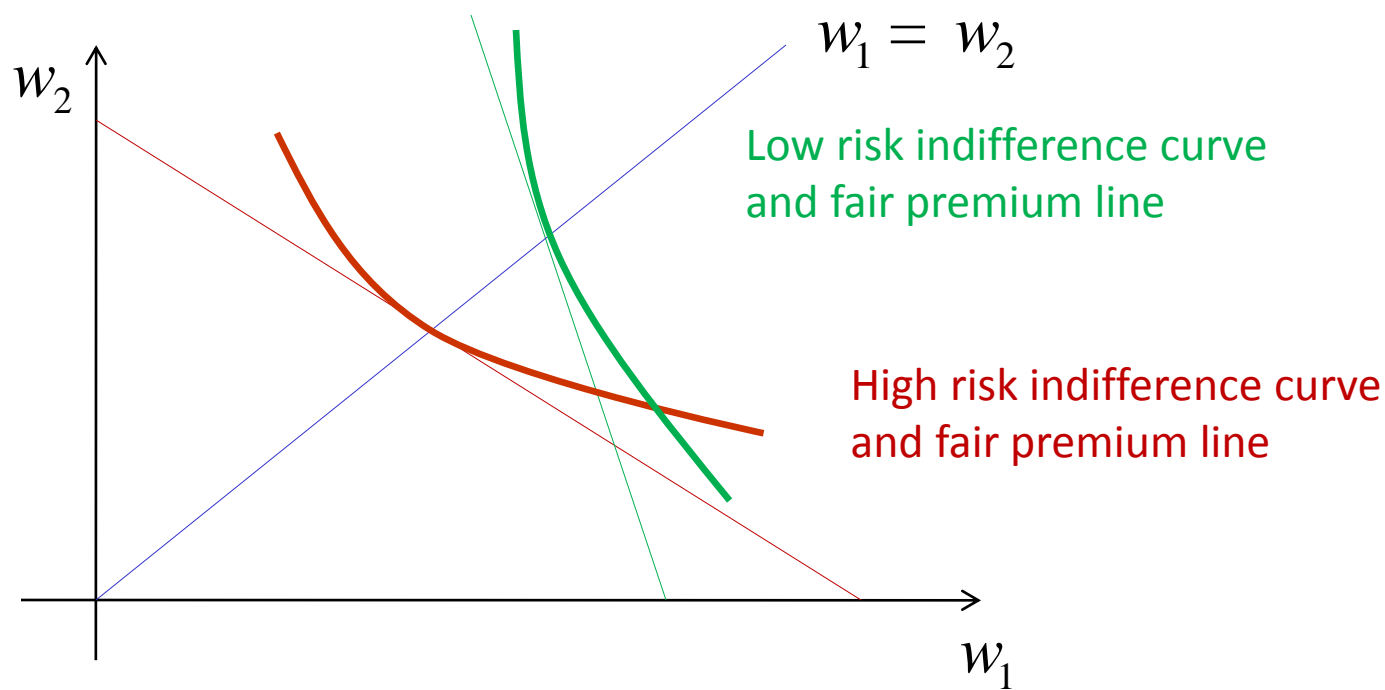


Mortality of life annuitants

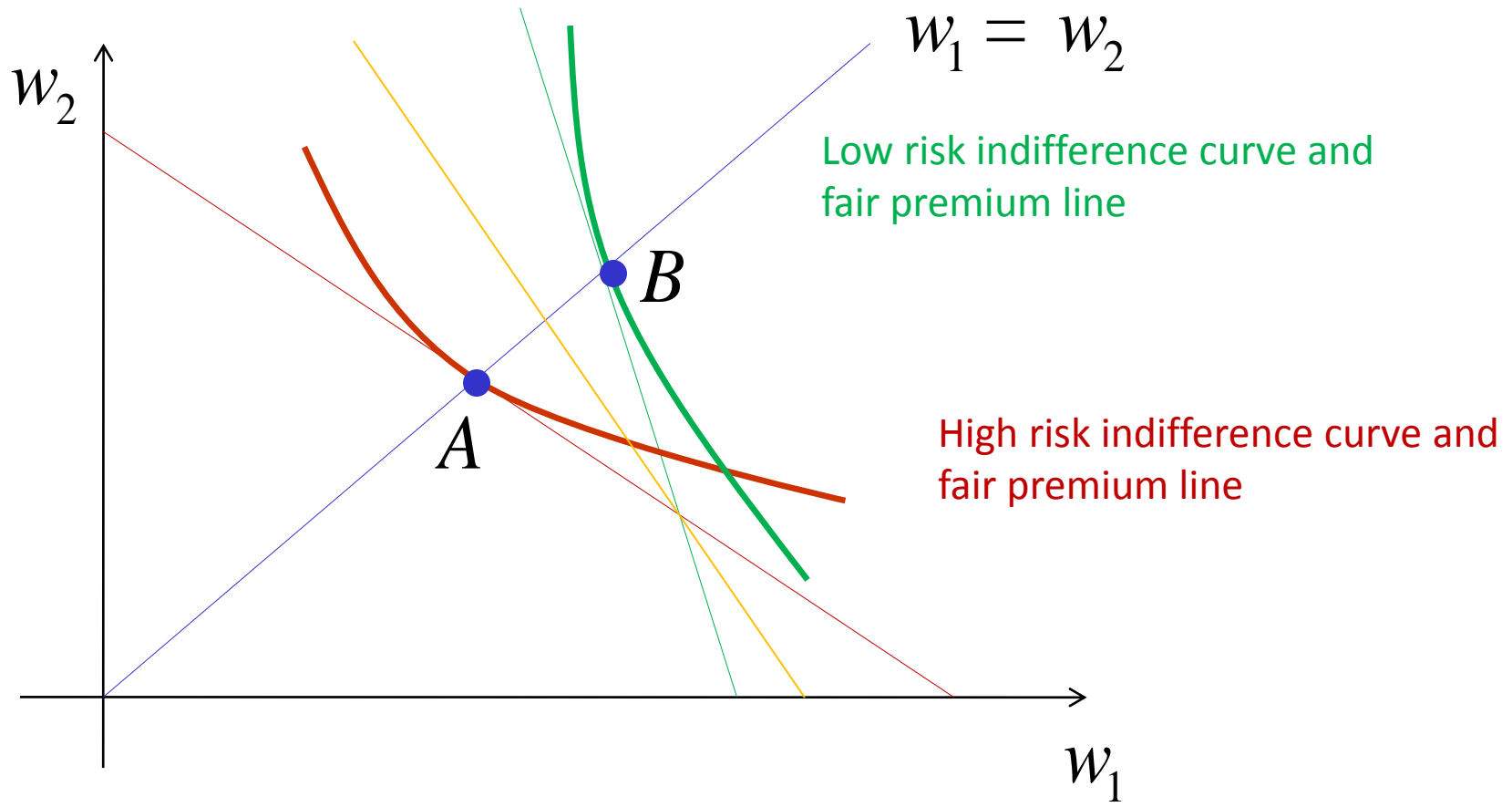
- People who purchase life annuities live systematically longer than members of the general population
 - Should we be surprised?
 - People who purchase annuities are probably wealthier on average, and have some money to purchase annuities, and are probably more risk averse (?) and expect to live longer
 - Some of these could in principle be observed by life insurance companies, while some could not
 - Only unobservable information which is systematically correlated with life expectancy can cause adverse selection

Today's Nobel Prize idea

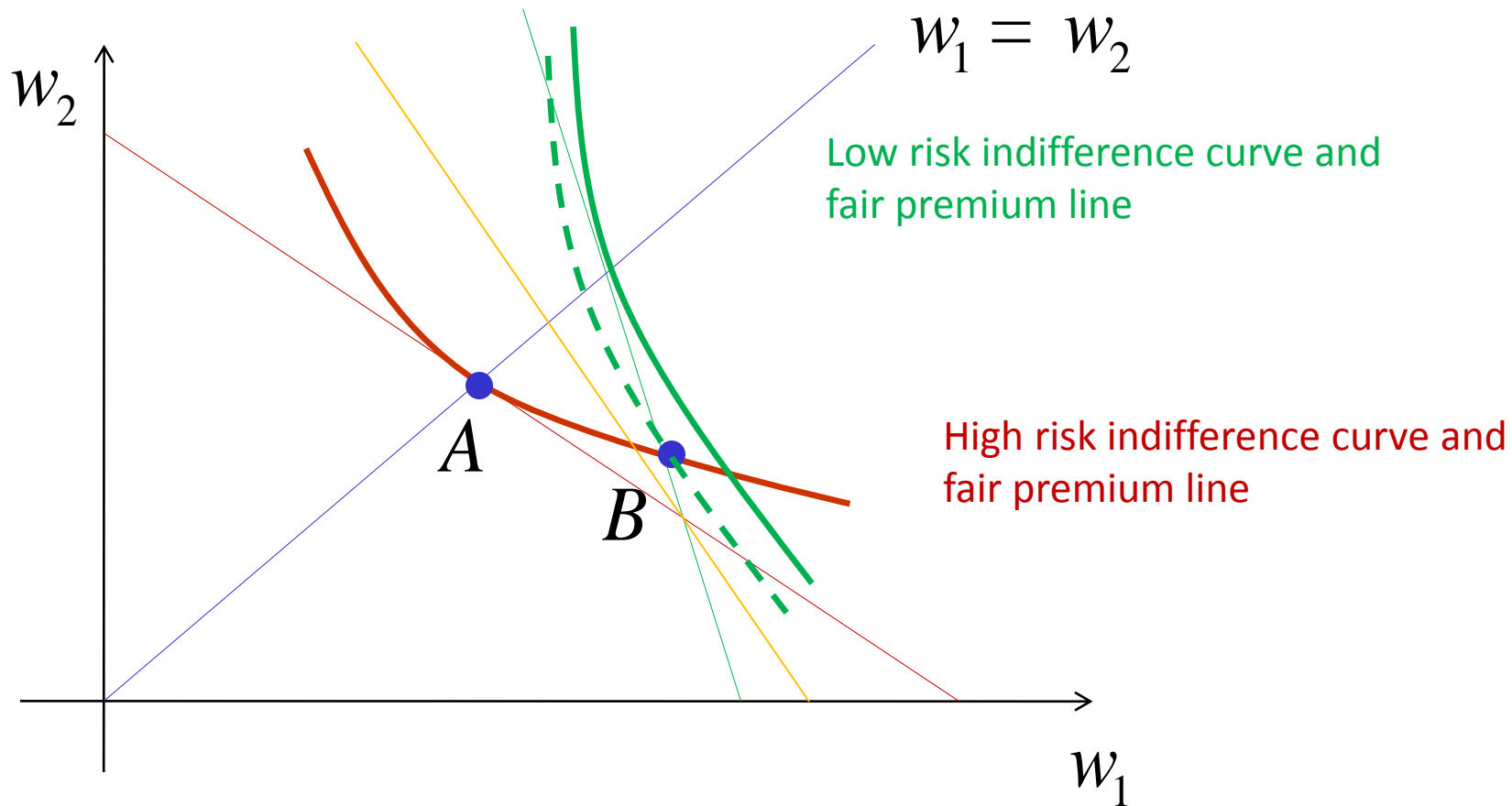
- This one was a paper by Joseph Stiglitz and Rothschild on insurance in the presence of asymmetric information



No pooling equilibrium



Separating equilibrium





Rothschild-Stiglitz separating equilibrium

- Insurance companies can design contracts to give agents an incentive to reveal their asymmetric information to the insurance company
- The high-risk types reveal themselves by purchasing full insurance
- The low-risk types reveal themselves by purchasing partial insurance
- Then you can charge each group accordingly and the equilibrium is maintained
- May fail in certain circumstances



R-S equilibrium and annuities

- Although a general separating equilibrium may be possible, a pure R-S equilibrium is not possible in the context of annuities markets because the size of the loss is not observable, and individuals can purchase more than one policy, implying that the company cannot observe when individuals are fully insured or not
- A famous paper by Philippon demonstrates that R-S equilibrium fails to hold in the US life insurance market, possibly for these reasons
- However, Abel demonstrates that because the demand for annuities is so high, a pooling equilibrium is possible even in the context of asymmetric information



Asymmetric information and annuities

- Some economists believe that asymmetric information problems might lie behind the failure of the voluntary annuities market (a lemons problem; “I wouldn’t join a club that would have me as a member”)
- Asymmetric information may drive annuity prices beyond the reach of most people, causing demand to fall
- We can do a number of tests to see if this is the case
 - See how expensive annuities actually are for most people
 - Test for separating equilibria



Annuity money's worth

- This is a measure of how expensive annuities actually are

$$AMW = \frac{EDPV(\text{Annuity Payments})}{\text{Annuity Price}}$$

- Given reasonable assumptions about the interest rate and expected lifespan of purchasers, how does the expected discounted present value of annuity payments compare with the price that is actually charged for the annuities?

Annuity money's worth

	United Kingdom		United States	
	Ann	Year	Ann	Year
Friedman and Warshawsky (1988)			0.868	1983
Mitchell <i>et al.</i> (1999)			0.865	1985
			0.926	1990
			0.927	1995
James and Vittas (1999)	0.966	1999		
	<i>0.878</i>	<i>1999</i>		
Murthi <i>et al.</i> (1999)	0.966	1999		
Finkelstein and Poterba (2002)	0.944	1998		
Brown <i>et al.</i> (2000)			0.937	1995
			0.929	1996
			0.938	1997
			0.974	1998
James and Song (2001)	0.983	1999	0.974	1999
	<i>0.894</i>	<i>1999</i>		
Cannon and Tonks (2003)	1.033	1964		
	1.004	1976		
	0.977	1984		
	0.976	1996		



Behind Abel's results

- Comparing these AMW's to the AEW's we calculated earlier illustrates that adverse selection cannot lie behind the small numbers of voluntary annuity purchasers: most people would buy annuities at these prices anyway
- This is the insight behind Abel's results: there is a trade-off between heavy need for annuities and the costs of adverse selection; the lower the need for annuities, the more significant the effect of adverse selection will be on the price



Testing for separating equilibria

- Finkelstein and Poterba (2002) claim to find evidence of separating equilibria in the UK annuity market
- They examine the mortality experience of holders of different types of annuity policies (e.g. guaranteed, inflation-indexed etc) using data from a large UK annuity provider
- They then compare the differences in these observed mortality rates to the assumptions that they infer were used in pricing...
- ... and demonstrate that these are equivalent
- Economically, effect is pretty small & I'm more convinced by Abel's work



Mandatory annuitisation

- In the UK, annuitisation of DC pension balances at retirement is mandatory
- Can anyone think of any reasons why this should be so?



Reasons for mandatory annuitisation

- Moral hazard
 - Individuals may be tempted to spend down their assets in order to take advantage of state means-tested benefits
- Asymmetric information
 - Making annuitisation mandatory solves the adverse selection problem
- Myopia
 - Individuals may spend down their assets unintentionally and be left destitute if balances are not annuitised



Happy annuitants

- There is some evidence that people who chose to annuitise their DC pensions, at least in the US, are happier in retirement than people who chose not to (Mitchell and Utkus, 2000)
- It is unclear whether annuities themselves are responsible for this difference (there may be an endogeneity problem here)



Economist's toolkit: endogeneity

- If you were to do a regression of the number of times a student sees his dissertation advisor and the final grade that he gets on the project, you would find that each supervisor appointment reduces the grade by around 5%
- Is it logical to conclude that the supervisor is sabotaging the student's dissertation?
- This, in economics, is called endogeneity, and it is the result of causation running the wrong way in a regression
- In most economic regressions it is almost always present, and econometrics as a discipline evolved to try and deal with it statistically



International policies on annuitisation

- Only a few countries insist on mandatory annuitisation of DC pension balances (e.g. UK does; US does not)
- This suggests that there is some room for disagreement about the “correct” policy
- Moral hazard and myopia only argue in favour of a minimum level of annuitisation, not the annuitisation of an entire pension (or indeed 75% of one)
- So it’s really unclear what purpose mandatory annuitisation as practised in the UK serves
 - Exposes individuals quite heavily to annuity price risk at retirement, too



International annuities markets

- Mortality information is generally quite scarce internationally
 - Most countries rely on UK or US mortality tables, particularly in developing countries
- Furthermore, the matching assets insurers require to sell annuities are absent in most countries (what is the matching asset?)
- A possible solution to this problem is the “with profits” annuity (this may even be desirable in the UK)



Alternatives to mandatory annuitisation

- Phased withdrawal
 - Individuals are permitted to withdraw their assets from their DC accounts at a specified pace or slower
 - The maximum pace bears some relation to the cost of purchasing an annuity, so that individuals do not decumulate too rapidly
 - In the US, the IRS specifies a *minimum* pace of withdrawal for tax reasons
- Lump sum up to a point
 - Some countries permit lump sums provided that the account balance doesn't fall below a subsistence level



Segmentation of annuity market

- Risk classification can be applied to annuity markets reasonably easily
 - E.g. ill-health annuities; smoker's annuities
 - Life would be underwritten and a price for annuity would be determined
 - Competitive forces would encourage the development of these annuities, and they make the annuities market more efficient
 - Problem is the lack of data in most annuities markets – segmentation seriously increases this problem



Conclusion

- We examined the economics of annuities markets
- Discussed possible reasons for low demand, and presented evidence, theoretical and actual, in favour of our hypothesis
- Examined AEW and AMW's
- Examined some issues in annuity supply
- Examined mandatory annuitisation
- Examined risk classification in annuities markets