Problem Set #3
14.41 Public Economics

DUE: October 29, 2010

1 Social Security

DIscuss the validity of the following claims about Social Security. Determine whether each claim is True or False and present a concise explanation for your answer:

1. Social security is inefficient because it provides an annuity. Welfare would be improved if it paid out a lump-sum at retirement and allowed individuals to purchase annuities on their own in the free market.

   - False, provided that the market for annuities suffers from adverse selection. Annuities provide consumption smoothing and insurance against "living too long". Yet, some individuals may prefer to consume more at different points in time (e.g. take a cruise at age 66, but just sit at home at age 90). If social security paid out a lump sum at retirement and allowed individuals to purchase annuities on their own, this could improve welfare. However, if the annuity market suffers from adverse selection (so that individuals use their private knowledge of future mortality to purchase varying annuities) then allowing individuals to buy insurance in the free market may not be as efficient as a forced annuity mandate. [Note: responses of "True" are acceptable, provided they state that this requires the market for annuities to not suffer from adverse selection].

2. Programs like social security, provide a work dis-incentive that is identical to the dis-incentive from an income tax because they tax individual's earnings while working

   - False. Income taxes provide general revenue to the government that provides benefits to everyone regardless of inputs. Forced savings programs provide contributors with benefits that are proportional to inputs, thereby reducing the work dis-incentive relative to an income tax.

3. Many economists have found that an individual's consumption expenditure declines at the onset of retirement. Since consumption is not perfectly smoothed, this proves that agents are not fully insured against leaving the labor force.

- False. Full insurance for risk-averse individuals requires the equating marginal utilities across time, not necessarily equating consumption across time. Individuals may have a higher marginal utility of consumption when working relative to when being retired. There are many reasons to think that retired individuals have a lower marginal utility of consumption. For example, if labor and consumption are complements in the utility function, then when labor declines (as occurs at the onset of retirement), the marginal utility of consumption declines. [Note: statements of "True" will be accepted, provided individuals state explicitly that they are assuming retired individuals have the same marginal utility of consumption when working as when being retired].

2 Social Security Example

Question Two

(a) Lifetime B.C. $= 300 = c_1 + \frac{c_2}{1+r}$ (in period 1 dollars)

$$\iff c_2 = (1+r)(\underbrace{300-c_1}_{\text{'savings'}})$$

Agent Max$_{c_1,c_2}$ Patient $\frac{3}{5}\ln(c_1) + \frac{2}{5}\ln(c_2)$

s.t. $c_2 = (1+r)(300-c_1)$

$\Rightarrow c_1^* = \frac{3}{5}(300) = 180$ (using 14.01 trick)

$\quad\quad\quad\quad\quad\quad\quad\quad\quad$ $\Rightarrow$ see: Cobb-Douglas Preferences

$\Rightarrow s^* = 300 - 180 = 120$

(b) (i) 'Fully Funded' Social Security system.

(ii) Revised B.C.: $c_2 = 50(1+r) + (1+r)(300-50-c_1)$

$$\iff c_2 = (1+r)(300-c_1)$$

$\Rightarrow$ Agent faces an identical constraint

$\Rightarrow c_1^* = 180$ (as above)

$\quad\quad\quad$ Now, $s^* = 300 - 50 - 180 = 70$

(iii) Effective total savings $= s^* + 50 = 120$, the same as in part (a). Thus mandatory SS savings resulted in full crowd-out.

c_1^*, c_2^* unchanged $\Rightarrow$ No effect on welfare. (well-being)

(c) (i) Agent Max$_{c_1,c_2}$ Impatient $\frac{9}{10}\ln(c_1) + \frac{1}{10}\ln(c_2)$

s.t. $c_2 = 50(1+r) + (1+r)(300-50-c_1)$

$\Rightarrow c_1^* = 270$

$\Rightarrow s^* = -20$ (agents borrow 20 in period 1)

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(ii) • Without SS, there impatient agents

$$Max_{c_1, c_2} \frac{9}{10} \ln(c_1) + \frac{1}{10} \ln(c_2)$$

$$s.t \quad c_2 = (1+r)(300 - c_1)$$

$$\Rightarrow c_1^* = \frac{9}{10}(300) = 270$$

$$\Rightarrow s^* = 30$$

$$\Rightarrow c_2^* = (1+r) \, 30$$

Yielding $U_{impatient}^{Noss} = \frac{9}{10} \ln(270) + \frac{1}{10} \ln((1+r)30)$

• Now, with imperfect credit markets, $s^* = 0$ (cannot borrow)

thus $c_1^* = 300 - 50$, $c_2^* = \underbrace{(1+r) \, 50}_{\text{only SS income}}$

Yielding $U_{impatient}^{SS} = \frac{9}{10} \ln(250) + \frac{1}{10} \ln((1+r)50)$

$\Rightarrow$ Social Security (w/ imperfect credit markets) is forcing the impatient agents to save more than they optimally would allocate, necessarily decreasing their utility. (made worse-off)

$\hookrightarrow$ by virtue of utility maximization

(iii) • The above preferences are fully rational, and forcing the impatient agents to save actually hurts them.

• Of course, if we think individuals have a self-control problem, forcing them to save may improve lifetime utility (paternalistic argument).

(d)(i) Unfunded Social Security system. or 'pay-as-you-go'

(ii) Individuals now solve =

$$Max_{c_1, c_2} \frac{3}{5} \ln(c_1) + \frac{2}{5} \ln(c_2)$$

$$s.t. \quad c_2 = 50 + (1+r)(300 - 50 - c_1)$$

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Substitution $\Rightarrow$ Max_{C_1} $\frac{3}{5}\ln(C_1) + \frac{2}{5}\ln\Big(50 + (1+r)(300-50-C_1)\Big)$

FOC $[C_1]$: $0 = \frac{3}{5}\cdot\frac{1}{C_1} + \frac{2}{5}\cdot\frac{1}{\big(50+(1+r)(300-50-C_1)\big)}\cdot\big(-(1+r)\big)$

$\Longleftrightarrow$ $3\cdot\cancel{5}\cdot\Big(50+(1+r)(300-50-C_1)\Big) = 2\cdot\cancel{5}\cdot(1+r)\cdot C_1$

$\Longleftrightarrow$ $150 + (1+r)750 - 3(1+r)C_1 = 2(1+r)C_1$

$\Longleftrightarrow$ $5(1+r)C_1 = 150 + 750(1+r)$

$\Longleftrightarrow$ $C_1^* = \frac{30}{1+r} + 150$

$\Longrightarrow$ $S^* = 300 - 50 - C_1^*$

$\Longleftrightarrow$ $S^* = 250 - \Big(\frac{30}{1+r} + 150\Big)$

$\Longleftrightarrow$ $S^* = \frac{100(1+r)-30}{1+r}$

$\Longleftrightarrow$ $S^* = \frac{70 + 100r}{1+r}$ (private savings)

(iii) National savings is almost certainly lower, as the \$50 is paid directly to the older generation, rather than an interest-bearing account. In order for National savings to have increased, private savings must be >120 (as before, private savings were 70, and government savings were 50 per person).

Consider r: $S > 120$

$\Rightarrow \frac{70+100r}{1+r} > 120$

$\Longleftrightarrow 70 + 100r > 120 + 120r$

$\Longleftrightarrow 0 > 50 + 20r$ (which $\underline{cannot}$ hold for $r>0$)

(Note: Even if $r=100$, $S^* \approx 99.70 < 120$)

(e)(i) When baby boomers are young, there are 2 workers for every 1 retiree.
Thus rather than the usual $50, each retiree receives $100. (Revenue = $2N \cdot \$50$, N retirees)

(ii) When baby boomers retire, there is only 1 worker for every 2 retirees.
So rather than the usual $50, each retiree receives $25. (Revenue = $N \cdot \$50$, 2N retirees)

(iii) If the government established a <u>trust fund</u> when baby boomers are young (as in the US) and <u>SAVE</u> that money (unlike the US), then even at $r=0$, each retiree would receive the usual $50. If $r>0$, then baby boomers would receive $\$25 + \$25(1+r)$ in retirement ($> \$50$).
That is, save $N \cdot \$50$ (half of revenue) when baby boomers are working (pay $N \cdot \$50$ to then-retirees), and then when retired spend revenue ($N \cdot \$50$) and the trust fund $N \cdot \$50 (1+r)$).

(f) (i) The Fully Funded system handles the baby boom better, and the flow of benefits is unaffected by population demographics.

(ii) Legacy Debt!
Either = ① cut off current retirees
② double the SS tax (transitory)
Neither is politically feasible.

3 Unemployment Insurance

Consider the Unemployment Insurance (UI) program in the United States, which typically replaces 50% of a worker's wages for up to 26 weeks after job loss. Evaluate the following claims by determining whether each claim is True or False and present a concise explanation for your answer:

1. The empirical observation that those receiving UI benefits remain unemployed longer than those not receiving UI benefits, conditional on unemployment, indicates that UI causes longer unemployment spells.

   - False. We need to know why some individuals receive UI and others do not. If the provision of UI benefits is random, then the claim would be true.

2. Assuming that UI causes longer unemployment spells, this clearly indicates that generosity of the program should be reduced.

   - False. The downside of the moral hazard created by UI must be weighed against the consumption smoothing benefits of the program.

3. Individual perfect experience rating - where the government effectively loans to individuals 50% of their wages while unemployed, but individuals have to repay the loan once re-employed - would result in longer unemployment durations and increased likelihood of worker layoff.

   - False. This scheme would remove the moral hazard component and likely decrease unemployment durations and lower incidence of unemployment.

4. Assume that UI causes individuals to become more "picky" about their job choices, passing up jobs that are less pleasant or pay less wages. While everyone would like to have nice jobs, this increased picky-ness is socially inefficient.

   - False. Pickiness can be socially efficient. If individuals are liquidity constrained, they may choose to take a less efficient job match (e.g. a PhD working at McDonalds) in order to prevent extremely low levels of consumption, although this is not their most productive potential job. It would likely be more efficient for this individual to wait and pursue a job that more closely relates to her skills.

5. Assume it is true that the extension of unemployment insurance benefits during economic downturns hinders the economy's GDP by preventing workers from going back to work and thus prolongs the length of a recession. Then, it follows that the government should not extend unemployment benefits during an economic downturn.

   - False. GDP is not the correct metric for evaluating the benefits of social insurance programs. UI may provide consumption smoothing benefits to those during recessions, and may be especially important during recessions.

4   Testing for Insurance

Suppose Barack Obama has asked you for your opinion on whether or not the government should raise the amount of benefits provided to individuals with a disability (aka DI). He asks you a series of questions. For each question, discuss a potential empirical method that would allow you to answer his question. Most importantly, discuss the potential limitations of your proposed approach. Assume you have access to any reasonable amount of data that would be required.

1. Obama asks: "I'm not sure if people are sufficiently insured against the onset of disability, since they potentially have access to informal sources of insurance and can also buy some insurance in the private insurance market. Can you tell me, given where we're at today, to what extent are people currently insured against the onset of a disability?

   - While an initial response might be to just look at what fraction of people have bought private insurance against disability, this is not a very good measure of the actual amount of insurance people have, since informal insurance may be important. Therefore, to capture informal insurance, one would ideally test for consumption smoothing. Assuming one has data on individual consumption levels, one could test whether the onset of disability is associated with a drop in consumption. Assuming that we have data on consumption levels of the disabled, this involves a simple regression of the form $c_i = a + b * disability$. However, one might think that the onset of disability is more common among poorer households, therefore our disability estimate, b, may be negative simply because those that experience a disability are poorer. A slightly better method would be to use panel data and analyze the incidence of disability within the same person, estimating
   $$c_{it} = a_i + bdisability_{it} + \varepsilon_{it}$$
   so that b captures the within-person difference in consumption between being disabled and not.
   A key limitation here (as discussed in question 1) is that disabled individuals have the same marginal utility of consumption as able individuals. If we think this is a problem, there are no perfect solutions. But, I'll consider two here: 1) one solution might be to analyze the consumption response of household members of individuals that become disabled. If their consumption drops as a result of their household member becoming disabled and no longer working, then perhaps this is more plausibly representing a lack of insurance as opposed to simply a difference in marginal utility when disabled. 2) a second solution may be to analyze the consumption path of individuals who are insured using formal disability insurance. If their consumption drops less than those without insurance, then perhaps we can conclude that those without formal insurance are indeed not fully insured. However, this faces the limitation that perhaps those that purchased insurance have a strong preference for consumption smoothing, while those that chose

not to purchase insurance have a lower marginal utility of consumption in the event of disability.

2. Obama asks: "All of these Republicans keep telling me that if we raise the amount of disability benefits then we'll see more people stop working and claim to be disabled. I see this could be a potential problem, but how large is this effect?

   - The ideal test would randomly vary the length of potential disability benefits and then analyze the fraction of people that become unemployed (and for how long they remain unemployed - but this wasn't explicitly his question). If one has randomly varying disability benefits, then this approach is the "gold standard" and suffers very few limitations in assessing the impact of disability benefits on unemployment incidence. In practice though, one needs to worry that actual benefit lengths are not set randomly, and may be correlated with the potential for unemployment. In this case, our estimates may over-state the impact of generous benefits, since states with generous benefits may be those that also experience high unemployment. To solve this, one might use panel data and include state fixed effects. But, this then requires that the changes in state policies are uncorrelated with future unemployment expectations. For example, if MA increases its benefit levels because it expects many people to be unemployed next year, we might mistakenly assign this change in unemployment to the policy change, as opposed to the other way around.

5 Adverse Selection

This question is difficult, but we hope it will illuminate the potential problem that markets have with dealing with adverse selection. So please do not get discouraged. Consider the Rothschild and Stiglitz model of insurance discussed in class and recitation. In particular, assume that people in the economy have the same wealth W and each face a potential loss of size L. However, individuals vary in their probability of experiencing this loss: A fraction λ are high risk and have a probability p_H of a loss, while a fraction $1 - \lambda$ are lower risk and have a probability $p_L < p_H$ of a loss. Assume that the probabilities are private information to the agent. Agents maximize their expected utility defined by their own (privately known) probabilities of having the loss, L. Suppose that there exists a competitive insurance market that consists of insurance companies attempting to maximize profit by providing insurance contracts. Recall from recitation (and 14.01) that a Nash equilibrium is a set of offered contracts such that after consumers choose their most prefered contract, we have that a) no offered contract makes negative expected profits and b) no unoffered contract could make a positive expected profits.

1. Graphically depict the maximization problem and discuss the only potential Nash equilibrium. Graphically describe why a pooling equilibrium (in which the L-type and H-type accept the

same contract) cannot exist. Explain intuitively what is going on.

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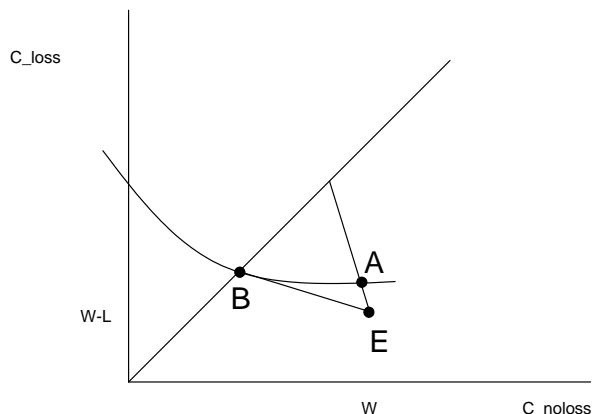
The only possible Nash equilibrium is depicted by points A and B. These points lie on the zero-profit lines for the H and L types. The H type receives full insurance at point B, while the L type receives less than full insurance at point A. To see that a pooling equilibrium cannot be a Nash equilibrium, consider the following picture:
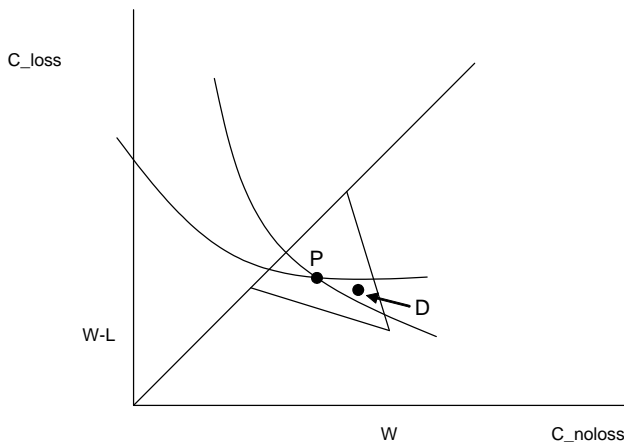
Point P is a candidate pooling equilibrium. As we move from point P to the lower right, the indifference curve of the L type lies below the indifference curve of the H type (because $p_L < p_H$). Therefore, we can find point D that would only attract L types, as long as point P is still offered. If contract D only attracts L types, it will be (highly) profitable, since point D lies below (and to the left) of the L-type zero-profit line. Therefore, no such pooling equilibrium can exist. Intuitively, firms cannot pool types together in a Nash equilibrium because they always have an incentive to "cream skim" the other firms pooling contract by offering slightly less insurance and attracting away all of the good risks, leaving the only the bad risks to take the pooling contract.

2. For the rest of the problem, suppose that a 3rd type enters the economy and has a 100% probability of a loss. Assume however that this type represents only a very small fraction, ε,

of the total population so that the population fractions are given by

Probability of Loss	Fraction of Population
p_L	$(1 - \lambda)(1 - \varepsilon)$
p_H	$\lambda(1 - \varepsilon)$
1	ε

Depict the problem graphically and solve for the only potential Nash equilibrium. How does your answer depend on ε? Why does this happen?

- Once the 3rd type with a probability of 1 enters the market, the insurance company cannot provide any insurance in a Nash equilibrium. The 3rd type values consumption only in the event of a loss (since she has no chance of not experiencing a loss). Therefore, she will choose any contract that provides more than her endowment in the event of a loss. As a result, no contracts that provide any amount of consumption above the endowment (W-L) in the event of a loss can be offered by firms in a Nash equilibrium. To see this graphically, we can add the 3rd type's zero-profit and utility curve into the picture from part 1.
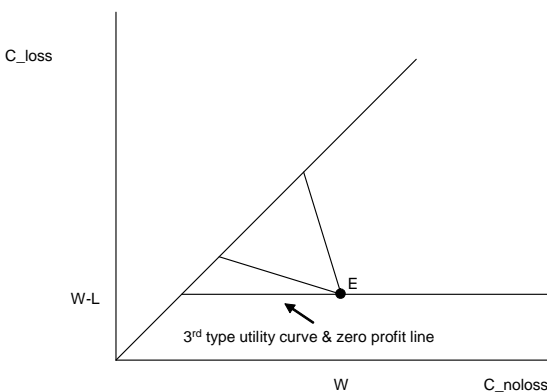

In any Nash equilibrium, the L and H types must receive their endowment, E, since it corresponds to the intersection between the IC curve and zero profit lines. For the 3rd type, she could accept any contract that provides $W - L$ in the event of a loss. She could, theoretically, receive a contract that specifies payments in the event of no loss, and these payments are not uniquely pinned down by the problem. But this is because she receives a loss with probability 1; there's no chance that she'll not experience the loss. In sum, the only Nash equilibrium involves everyone receiving their endowment.

3. Now, think about whether or not your candidate Nash equilibrium solution in #2 above can indeed be a Nash equilibrium. In general this is difficult to prove, so we don't require that you do this. But, discuss intuitively, graphically, or prove mathematically if you can, what happens to the possibility for existence of a Nash equilibrium when ε is sufficiently close to

zero. Again, no math is required but may be useful depending on how you prefer to think about the problem.

- When ε is sufficiently close to zero, no Nash equilibrium exists. The L and H agents would like to pool with the 3rd type in order to remove the constraints imposed by her IC constraint. In particular, consider the decision of the H type. The dotted line in the following figure denotes the zero profit line for a contract that pools the H and 3rd type. As $\varepsilon \to 0$, this dotted line converges to the zero profit line for the H type. Since the H-type's utility is concave, there exists an $\varepsilon > 0$ such that the dotted line crosses above the utility curve of the H type, as shown in the figure. Point D represents the devating contract that breaks the possibility of the endowment being a Nash equilibrium. Point D lies below the dotted zero profit line (so it earns positive profits) and above the utility curve of the H type that runs through the endowment points, E (so that the H type chooses to accept the contract).
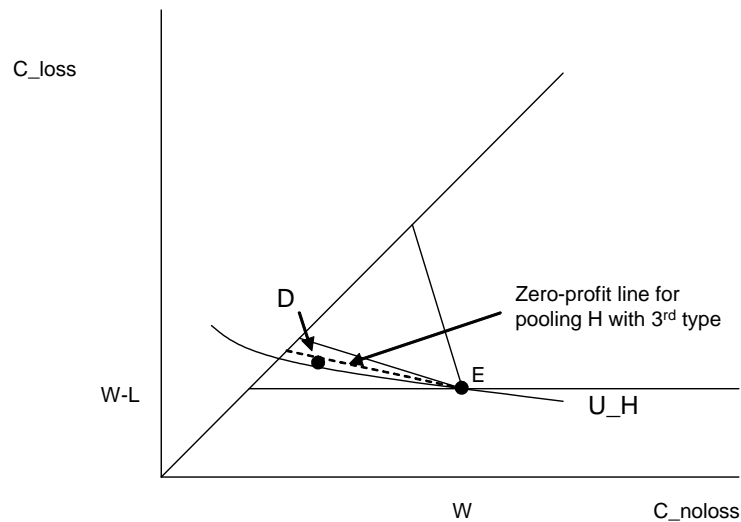
4. Discuss intuitively what contracts the agents with less risk (i.e. those with probabilities of p_L and p_H) would like to see offered by the insurance companies. Why does the market not provide this in the Rothschild and Stiglitz model? (For thought: do you think in reality the insurance market provides these contracts?).

- The p_L and p_H agents do not want to always be subjected to the incentive constraints imposed by horrible risks. While they would prefer they not be in the economy, they certainly don't want to have to buy contracts that subject them to the IC constraint of the worst risk in the economy; they'd prefer to "cross-subsidize" these bad types (e.g. by offering a pooling contract). In the Rothschild and Stiglitz model, these pooling contracts cannot exist because they result in firms cream-skimming each other (by taking the good type from the other firm's pooling contract), destroying the equilibrium. In reality, since we observe insurance contracts existing (and not blowing up a la Rothschild and Stiglitz

whenever there are a couple bad risks that enter an insurance market), we might think that the insurance market does not suffer the types of equilibrium existence problems posed by the Rothschild and Stiglitz model. That said, the model is straightforward and delivers shocking results given its relatively minor assumptions.

14.41 Public Finance and Public Policy

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