Notes - Gruber, Public Finance

Section 12.1

Social Insurance

What is insurance?

Individuals pay money to an insurer (private firm or gov). These payments are called premiums. Insurer promises to make a payment to the individual conditional on some event. For instance, flood insurance premiums paid to insurer. The insurer pays the insured if a flood occurs.

examples: Health insurance - insures against the costs of illness, auto insurance - insures against the cost of car accidents/theft, life insurance - pays income to heirs, casualty and property insurance - insures against loss due to natural disaster, theft.

Reasons for insurance

Consumption smoothing - individuals tend to prefer incomes that are similar in each period to wide differences in incomes across periods. This is due to the fact that individuals usually have diminishing marginal utility in consumption: For almost any good, the marginal utility derived from an additional unit falls as the amount of consumption increases. Thus, given a choice between 2 years of average consumption versus one year of very low consumption and one year of very high consumption, they would choose the first option: Excessive consumption doesn’t raise utility as much as starvation lowers it.

With uncertain outcomes, individuals want to smooth their consumption across outcomes. That is, they would like consumption in one eventuality to be as similar as possible to consumption in another eventuality.

Let State 1 be ”no accident” and state 2 be ”accident”. If the accident occurs, the individual will have to pay a lot of money. Then she smoothes her consumption over the two states by taking out insurance against an accident. If no accident occurs, her wealth will be lower than with no insurance, but if an accident occurs, her wealth will be higher than with no insurance.

Formalize the model

Use the expected utility model, where an individual’s predicted utility in the next period is the expected utility: That is the probability event 1 will happen times the utility if event 1 happens plus the probability event 1 doesn’t happen times the utility if event 1 doesn’t happen.

Or, letting $p$ equal the probability of event 1 happening, $EU = (1−p)U(\text{consumption if event 1 doesn’t happen}) + pU(\text{consumption if event 1 happens})$.

Suppose that Sam’s utility function over income levels is given by $U(I) = I^{1/2}$. This utility function has diminishing marginal utility, as the additional utility
from an additional dollar of income becomes less and less.

Compare three possibilities: No insurance, full insurance, and partial insurance.

With no insurance, Sam’s income is $30,000 if the accident doesn’t occur and 0 if the accident occurs. Suppose that $p = 0.01$; there is a 1% probability of the accident occurring. Then with no insurance, his expected utility is $0.99 \times (30,000)^{1/2} + 0.01 \times 0^{1/2} = 171.5$.

Assume only actuarially fair insurance is offered. This means that the price of insurance (the premium) equals the expected payment made by the insurer.

The insurance works this way: Sam pays a premium of $m$ per dollar of coverage. That is, if the insurance pays $b$ if the accident occurs, then his premium is $m \times b$. In the no accident state, his income will be $30,000 - m \times b$. In the accident state, his income will be $b - m \times b$.

Full insurance means that Sam’s incomes in both the accident state and the non-accident state are the same. Thus $30,000 - m \times b = b - m \times b$. Actuarially fair insurance implies that $0.01 \times b = m \times b$ (the expected payment made the insurer equals the amount received by the insurer). Thus $m = 0.01$. So to get actuarially fair full insurance, Sam must pay a premium of $0.01 \times 30,000 = $300.

When there are only two possible states, accident and no accident, actuarially fair implies that the premium per unit of coverage equals the probability of the accident. Full insurance implies that the payment if the accident occurs, $b$, equals the difference between income in the no accident state (without insurance) and income in the accident state (without insurance).

Under full, actuarially fair insurance, Sam’s expected utility is $0.99(29,700^{1/2}) + 0.01(29,700^{1/2}) = 172.34$.

This expected utility is higher than his expected utility when he buys no insurance. It is also higher than his expected utility when he buys partial insurance, under which his income is less when the accident occurs than when the accident doesn’t occur. This is because of the shape of his utility function, which has diminishing marginal utility in income.

Another way of describing Sam (due to the shape of his utility function) is that he is risk-averse. A risk-neutral person cares only about expected income; all income distribution over states that yield the same expected income are equivalent to such a person. A risk-loving person prefers risky income to a sure income with the same expected income. Such a person has a convex utility function over income. Most people seem to be risk-averse.

Chapter 12.2

Why have social insurance? Asymmetric info, adverse selection

If individuals could fully insure themselves at actuarially fair prices in the private market, there would be no need for government intervention. Yet there is a great
deal of government intervention in insurance markets.

Information asymmetry can lead to problems in insurance markets. It is the difference in information about risk available to the insurer versus the insured. Akerlof, The Market for Lemons (1970) described an extreme case of this problem for the market for used cars. Used car sellers know more about their car’s problems than buyers. Someone may be selling their car because it is a lemon. Buyers can’t trust sellers’ claims about their car. Buyers may avoid the market for used cars unless they absolutely have to buy one. Because buyers expect that sellers may try to sell them a lemon, willingness to pay for a used car is low. A seller of a decent used car will receive less for the car than it is worth.

Result is that some mutually beneficial trades in this market do not take place.

In insurance market, buyers of insurance know more about their risk (how long they’re likely to live, how careful they are about not getting into an accident) than sellers of insurance. Sellers of insurance expect buyers to have higher-than-average risk than the general population. Therefore they charge higher than actuarially fair premiums. But as a result, people who would have bought insurance at an actuarially fair premium no longer buy it. Again, some mutually beneficial trade does not take place. But since the insurers don’t know the exact risk of each buyer, they assume buyers have higher than average risk and price insurance accordingly.

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Chapter 12.2

Example: Full information

2 groups of 100 people each. Group 1 doesn’t pay attention when crossing the street. Each member of this group has 5% chance of getting hit by a car each year.

Group 2 is careful when crossing street. Each member of group 2 has 0.5% chance of getting hit by a car each year.

First assume that the insurers have full information about who belongs to each group. Again assume that income of each person with no accident is $30,000 and income with accident (if not insured) is 0.

Then insurer would charge different actuarially fair prices to each group. The careless would pay $0.05 per dollar of insurance coverage, and the careful would pay $0.005 per dollar of insurance coverage. At these prices both groups would choose to be fully insured (assuming they are risk-averse).

Careless would pay $30,000 × 0.05 = $1500 each year and careful would pay $30,000 × 0.005 = $150 each year in premiums.

Insurance company would earn zero profit (because of actuarially fair insurance). Efficient outcome would be achieved because everyone who wants to be fully
insured is.

Example: Asymmetric Information

Now the insurance company knows there are 100 careful and 100 careless people but doesn’t know which is which. They can’t ask who is careful - everyone will say they are careful to get insurance at a lower cost and the company will make a loss.

Instead, they could offer insurance at an average cost. They could base the price they charge each person on the total amount of payment made by the insurer, assuming that everyone buys full insurance. With this assumption (and actuarially fair insurance given the average probability of accident, 0.0275), total payment made would be $100 \times 0.05 \times 30,000 + 100 \times 0.005 \times 30,000 = 165000$. Dividing this by 200, each person would have to pay a premium of $825 per year.

However, the careful consumers will prefer to buy no insurance than to buy insurance at a premium of $825. Assume they each have a utility function of $U(I) = I^{1/2}$. If they buy this insurance, their income if they are not hit will be $30,000 - 825 = 29,175$. Their income if hit will be the same, 29,175. Their expected utility is $EU = 0.005 \times (29,175)^{1/2} + 0.995 \times (29,175)^{1/2} = 29,175^{1/2} = 170.8$. If they do not buy insurance, their income if they are not hit will be 30000 and their income if hit will be 0, giving an expected utility of $0.995 \times (30,000)^{1/2} = 172.3$ with no insurance.

So buying no insurance is preferable for the careful consumers. Thus they drop out of the market, leaving only the careless consumers to buy the insurance. But if only the careless types are buying insurance, the firm makes a loss. Since all buyers are careless, the firm’s expected payment is $0.05 \times 100 \times 30,000 = 150,000$, but its income is $100 \times 825 = 82500$.

Thus, the firm will change its price of insurance to reflect the fact that only careless types are buying insurance. It will give them full, actuarially fair insurance. The price of insurance will be $30,000 \times 0.05 = 1500$. All the careless types end up insured, while the careful types end up not insured. This is inefficient because the careful types would have wanted insurance as well if it could have been provided at a cheaper price.

However, this won’t necessarily happen whenever there is asymmetric information. Depending on the relative probabilities the different groups face of having an accident, and on the utility functions (level of risk-aversion) of the consumers of insurance, there could exist a pooling outcome, where types with lower risk still buy the insurance as well as types with higher risk.

For instance, suppose that, in the previous example, the utility functions of the careful types were all $U(I) = I^{1/8}$. Then their expected utility when they pay a premium of 825 will be $EU = 0.005 \times (29175)^{1/8} + 0.995 \times (29175)^{1/8} = 3.615$. Their expected utility when they buy no insurance will be $0.995 \times 30,000^{1/8} =$
3.6096, which is less. So depending on the utility function (the degree of risk aversion) of the lower-risk types, they could choose to buy insurance even at a price that is higher than the actuarially fair rate for them. This outcome, however is not an equilibrium, because another firm can come along and offer a better deal to the careful types that will take them away from the original firm (this is called cream-skimming). Then the original firm will be stuck with the careless types, and will have to change its policy (raise the price to the careless types) to remain at zero profit.

It can be shown that when all types have the same utility function, but there are two different groups with different risks, there is no pooling equilibrium. The reason is as described above (the possibility of cream-skimming).

When there exists no pooling equilibrium, an insurance company could address adverse selection by offering different products at different prices. How can they get the high-risk types to "reveal" their type?

The insurance company has to offer two different plans, such that high-risk types choose one and low-risk types choose the other. Suppose they offer two policies.

The first policy gives full coverage for the $30,000 in medical costs due to an accident. The price of the first policy is $1500, which is the actuarially fair price for the careless.

The second policy has coverage of up to $10,000 of medical costs, at a price of $50, which is the actuarially fair price at that level of coverage for the careful. (Check: The expected payment made by the insurer to a careful person under this policy is 0.005 × 10,000 = 50. So the expected net payment to the insurer is zero under this policy if only the careful take it - the price is actuarially fair).

Which policy will the careless take? Assume all careful and careless types have a utility function of \( U(I) = I^{1/2} \). Their expected utility with the first policy is 28,500\(^{1/2}\) = 168.8. Their expected utility with the second policy is 0.05 × 9950\(^{1/2}\) + 0.95 × 29950\(^{1/2}\) = 103.42, much less than their expected utility with full actuarially fair coverage.

The careful types’ expected utility under the first policy is also 168.8, since that does not depend on the probability of accident. Their expected utility under the second policy is 0.005 × 9950\(^{1/2}\) + 0.995 × 29950\(^{1/2}\) = 172.69, higher than the full coverage policy that is not actuarially fair to them. So with these utility functions, the types "separate" - the careful types choose the second policy and the careless types choose the first policy.

This outcome may not be an equilibrium though, because it’s not sure whether another firm could come and skim off the low-risk types. A necessary condition for an outcome to be an equilibrium in a competitive insurance market is that firms get zero expected profit, so in a separating equilibrium, they must get zero expected profit from each type. So the insurance policy offered to each type must
be actuarially fair. (Why is positive profit from one type not possible? Because another firm could offer a slightly lower premium and get all the customers of that type).

Now must determine how much insurance is offered in equilibrium. In the example above, the careful types are getting actuarially fair to them insurance, but not full insurance (if full, actuarially fair to the careful types insurance were offered the careless types would also take it). The careful types would like more insurance, though. So firms will continue competing to give them more insurance up to the point where careless types would switch from their (actuarially fair to careless, full insurance) policy to the policy for careful types. If there is a separating equilibrium, it must be: Policy 1: Full, actuarially fair insurance to the careless types; Policy 2: actuarially fair to the careful types insurance in the amount such that careless types are just indifferent between this policy and their policy.

But an outcome with these conditions is not necessarily an equilibrium. Thus, there may be no equilibrium at all.

Also, even if there is an equilibrium, the asymmetric information makes it less efficient than in the full information case. This is because less insurance than full must be offered to the careful types to prevent the careless types from choosing the policy aimed at careful types. But more insurance would benefit the careful types, while firms would get zero profit anyway and careless types would get the same insurance in either case.

Government’ ways of addressing adverse selection.

In the careful/careless pedestrian example, government could mandate that everyone buy full insurance at the average price of $825 per year. This would lead to an efficient outcome, although at this premium, careful would prefer to be uninsured. But if they did not buy insurance, the price to the careless would go up, making them worse off.

Or public provision - government could provide full insurance to both types of consumers. If this is paid for by equal taxes on everyone, it would be the same as mandating full insurance at the average price of $825.