[SQUEAKING] [RUSTLING] [CLICKING]

**JON GRUBER:** Today, we are going to be talking about continuing our discussion of health externalities. Now, if you remember last time we started with the example smoking, to remind you we talked about smoking as a negative consumption externality, something where the consumption of cigarettes by one person makes other people worse off.

We talked about where the externalities arise. First of all, we talked about the fact that smoking in standard economic models should only be regulated if it creates externalities on others. So if smokers just sit on a rock in the middle of nowhere and kill themselves that's their problem. In economics, the reason we regulate goods is the damage it will do to others.

The question is, where do the externalities arise for smoking? And we started-- and if you look at the-- we talked last time about some of the externalities for smoking and when they actually are return externalities. And so the first thing we talked about was increased health care costs. Health care costs.

And we said, is that an externality? We said, well, it's only externality if the smoker themselves doesn't bear it. If smokers pay for the increased health care costs through higher premiums and other things, that's not an externality. They've internalized it. It's only externality if smokers are, say, uninsured or paid for by the government. They don't bear it.

We can talk about other externalities in the same way. Let's think about another externality to smoking, which is work potential and effects on workplace productivity. So smokers have been measured to be less productive in the workplace than non-smokers. They take smoke breaks, et cetera. Is that an externality or not? Yeah.

**AUDIENCE:** Depends. If they're [INAUDIBLE] and they [INAUDIBLE].

**JON GRUBER:** Right. If it's reflected in their wages, it's internalized. It's not an externality. It's only an externality if they're not paying for it. The best estimates are they're not. So it is an externality.

Moreover, there's a lot of good economic research that the productivity of one worker spills over to the productivity of other workers. And as a result, even if they're paying for it, if they're less productive, that could make their coworkers less productive. That would also be an externality.

So that's another example. A third example that's quite striking is fires. Turns out that smokers cause a lot of fires in the world. In 2011, fires started by smokers in the US caused 540 deaths and $620 million of property damage.

Now, once again, if a smoker lives in a house by themselves in the middle of nowhere with no fire department and it burns their house down, that's their problem. But that doesn't happen. The externalities arise because A, you can burn your neighbor's house down. That's an externality.

B, the fire department has to come, raising everybody else's taxes. That's an externality. So once again, we want to think about what's internalized is what people pay for. What's externalized is what others bear without them paying for it.

Now, there's an interesting twist on all of this, which is-- we focused on the negative, but smoking actually has a big positive externality. Turns out there's a big positive externality for smoking. And it's because smokers have a convenient habit of dying at age 65.

Why is that convenient? It's convenient because they've paid Social Security taxes their whole life, and they don't collect the benefits. They even have a name for this. They call it the death benefit. The death benefit is a positive externality, which is smokers essentially pay into pensions.

A lot of what we do in our life is paying when we're young to get benefits when we're old. Well, if die before you're old, you don't get those benefits. You're paying those to other people. That a positive externality.

Indeed, it's so big that many have argued that on net, smoking is good for society. And indeed, the best estimates are the negative externalities of smoking are pretty small, maybe around $0.50 a pack.

So about $0.50 a pack is the net damage done to the society, which is actually, current cigarette tax at the federal and state level are running between $2 and $5 a pack. That seems like, wow, that's a lot smaller than the taxes.

But that misses two things. The first thing, and this is one thing we haven't discussed, which is secondhand smoke, the fact that when I smoke, that can affect you. Now let's think about why that's an externality. It's an externality because-- well, let me give an example of it not being an externality.

Imagine instead of secondhand smoke, I smoked and I just jammed my cigarette in your arm. That would not be an externalities. If that's what caused secondhand smoke, why would that not be externality?

**AUDIENCE:** Why would you do that?

**JON GRUBER:** Someone else. Let's get some other folks involved. Yeah, why is it not an externality?

**AUDIENCE:** Because that's a very concrete-- you are damaging this person.

**JON GRUBER:** Yeah. But what does he have over his arm? What's important about his arm?

**AUDIENCE:** His arm?

**JON GRUBER:** He has property rights over his arm. So Coase should work. Basically, if I jab him, he can sue me. He can punch me. He can make me bear the consequences of that damage. Why is secondhand smoke not like that? Because no one owns the air.

So when I smoke and that smoke goes in the air and the people get damaged, there's no property right. And that's why there can be no internal solution to that. So that's one reason why there's secondhand smoke-- damage with secondhand smoke.

But there's another wrinkle too, which is most of the damage done from secondhand smoke is done to family members. OK? I've been talking about this example. My wife, who has never smoked, but her mom was a three pack a day cigarette smoker. And she now has COPD, pulmonary disease, from her mom smoking in the house. Is that an externality? When is it and when is it not an externality? Yeah.

**AUDIENCE:** It is not an externality if it's paid for by her mom.

**JON GRUBER:** Well, yeah. Her mom could pay for it, but her mom's dead. She's not paying her health insurance bills. Why else might it not be an externality? Why else might it not be an be an externality? Yeah.

**AUDIENCE:** Because your decision to smoke takes into account the cost that you cost your family member.

**JON GRUBER:** Exactly. If you have a family utility function where you're maximizing not your own utility but your family's utility, then that's not an externality. So in a family utility function, my wife's mother said, look, I know when I smoke, I'm creating this externality on my daughter.

That doesn't mean she shouldn't smoke. It just means that she should really, really want to smoke before she does so. Doesn't mean smoking's wrong. It just means she-- just like addiction doesn't mean smoking's necessarily wrong. It just means that that's something she should account for.

So if people have family utility functions, that secondhand smoke is not an externality. Turns out people don't have family utility functions, especially men. And we know this because there are dozens of studies in the developing world which test the key prediction of a family utility model.

What's the key prediction is that $1 in the hands of any family member should be spent the same. If we all have a family utility function, then if mom or dad gets the dollar, they should spend it the same, because they're maximizing the same objective function.

But in fact, that's not true. When women get the money, they spend on their kids. When dads get the money, they spend it on beer. OK? So basically there's a strict rejection of family utility functions. And as a result, we don't think people are maximizing family utility functions.

And so secondhand smoke would be an externality even if it's damaging family members as well. This is all kind of esoteric. But it's just to raise the point that we think critically about when externalities arise and when they do not.

Now, once again, measuring externality of secondhand smoke is very hard. The estimates are in the narrow range of $0.01 per pack to $2 a pack. We really have no idea how big these effects are.

But even at the upper end, even if you add that to the other estimates, it's still not that big. It's maybe $2 a pack. That's still not that big compared to the number of taxes. So are we overtaxing cigarettes?

Well, as I mentioned, I worked in the Clinton administration. And in the Clinton administration, I was very-- when I worked in government, I was very proud of being an economist because we are so much smarter than lawyers.

And when I was in the room, it was me and a bunch of lawyers. And I always would make points that-- it's just, the framework you get in 14.01, the framework you get here helps us think critically about these problems the way lawyers don't get.

Except for one time, when you want to stand up in front of a group of lawyers and explain the death benefit and say we should tax cigarettes less because they kill people. And they were like, that's kind of stupid. And I was like you know what, that's right. That is kind of stupid.

And so I came back from Washington, embarked on a research agenda, which was trying to understand what's wrong with it. And I realized what's wrong with that is that it's a fundamental flaw in the model we use to model smoking decisions, which is we ignore two critical things.

The first thing we ignore is that smoking decisions are made by young people. Now, even if you're the most rigid Chicago economist and think that at age 21, we're all perfectly-formed economists, we almost agree at age zero, we're not.

And therefore, there's got to be some glide path along which we start making decisions the way we should. And that means that teenagers are probably not on that glide-- not fully glid, if that's a word. That means that teenagers are not-- teenagers making the vast majority of smoking decisions are maybe not acting in their own long-run utility, maximizing self-interest.

My favorite fact of any research project I ever did was the fact that I discovered doing research on smoking, which is there's a survey in Michigan that asked high school students who smoke a pack a day, do you think you'll be smoking in five years?

And they followed about five years later. What they found was among those who said, yes, I'll be smoking in five years, 72% were smoking. Among those who said, no, I will not be smoking in five years, 74% were smoking.

And this is the key thing about irrationality around smoking. It's not that people don't know smoking is bad for you. Indeed, if you ask smokers how bad smoking is for you, on average, smokers think it's actually worse for you than it is.

It's that smokers think they'll all escape the consequences by quitting. They don't understate the damage to smoking, they understate the addictiveness. OK, so if you ask smokers-- here's a great fact.

If you ask smokers how long the typical smoker will live, they get the answer right. You ask them how long they'll live, they say seven more years, because they think they're going to escape the consequences. OK, so that's the first problem with the standard model. It's that kind of irrationality.

The second problem with that model is that even among adult smokers, they face what we call a self-control problem. A self-control problem. And this is really the core. I cover this a bit in 14.01, if you took that with me, the core of the field of behavioral economics.

If you remember, just a bit of a primer. Remember, in behavioral economics, the key trick is, how do we minimally adapt our models to capture some of the realities of psychology that are ignored by standard economic models?

And perhaps the most significant article in this literature was an article written by David Laibson in the 1990s at Harvard, where he talked about a model of what we call hyperbolic discounting, which is a model where basically, people don't think rationally about the distant future relative to the near future.

That essentially, when we write down our standard over time utility model, we typically write as utility at a point in time equals the sum of the discounted stream of future consumption. So it's basically consumption today times a discount rate with delta less than 1 sum from t equals 0 to cap t. The sum from t equals 0 to cap t.

That's how we write it. That's called an exponential discounting function. You assume that-- so if delta is, say, 0.9, then next year is worth 0.9 of today. Two years is worth 0.81 of today. Three years, et cetera. We assume every period we discount by 90%.

However, that's not the reality of how people behave. So they ran the following experiment. They asked people, imagine I can give you $100 today at t equals 0, or $200 in one year at t equals 1. Would you take that deal?

And most people said, I'll take the $100 today. Then they said, what if I offered you $100 at t equals 5 or $200 at t equals 6? Now, you should see with this mathematical function, that's an identical choice. Because all that matters is the delta between two consecutive periods. And that delta is always 0.9.

And yet in this case, everybody chose 200. Why? Well, because we don't discount exponentially. We discount hyperbolically, which is essentially we have an ever-decreasing discount rate the further we get in the future. We're more and more patient the further you get in the future.

Now, that's incredibly hard mathematically to model. So Laibson's insight was to write down what we call the quasi-hyperbolic utility function, which is that u equals today's consumption Ct plus some factor beta times the discounted sum consumption from t plus 1 to the future from t equals 1 to t. Sorry, just t. C to t delta t, but starting at t equals 1.

So in other words, you have today's decision. And then the entire future is discounted by the extra factor beta. So once you get to tomorrow, we're back to the standard model. But today versus tomorrow-- today versus that whole future-- is an extra factor beta. And beta is less than 1.

And that explains the kind of trade-offs we just described about the $100, $200 example. And what's cool about this model is this simple change, literally pulling the C out and adding this extra beta factor can explain a ton of the decisions we see in reality.

In particular, it can handle what we call the self-control problem, which is the notion that basically people are unable to take actions which have short-term costs and long-run benefits. And that's true for all of us.

We all face things with self-control problems. For me, it's biting my nails. OK? I know I should stop biting my nails. I know that that is a long-term detrimental effect. OK, it looks ugly, whatever. OK? I know I should stop, but if there's ever a close sports game or a tight deadline, I bite my nails.

I've tried to stop. I've tried to get that stuff you paint on your nails. I can't swear, because my niece and nephew in the back. So I'm going to try to stop swearing here. That stuff you paint on your nails so you don't bite your nails. Just makes it taste bad when I bite my nails.

I have a self-control problem when I bite my nails. We all have self-control problems around issues with a short-run cost and a long-run benefit. OK? Dieting, exercise. I always say before I get on a plane, I'm not going to eat the crappy food they're serving on the plane. But they put it in front of you. What are you going to do? You're going to eat the crappy food they serve on the plane.

We all have these kind of self-control problems. Once you have a self-control problem, the economic model changes radically. And it changes radically because we allow for the fact that smokers might not be making decisions in their own long-run best interests.

Now, Coase would say, well, that's ridiculous. If smokers face a self-control problem, they should just go ahead and implement processes to fight that self-control problem. And smokers do. If you look at-- in fact, the best evidence that folks suffer self-control problems is to look at all the recommended ways to quit smoking.

They're all "make your life miserable if you smoke". They're "put your old cigarette butts in a jar of water", "give someone $1 every time you smoke". Now, those are things where in a rational model, you'd never do. Why would you ever make yourself worse off?

But in this model, you would. Because remember, the payoff is long-term benefits-- you live longer-- against short-term costs-- it's really painful to quit. So I bring the cost to the short term. You balance it out.

When my kids were in elementary school, they got an anti-smoking bookmark. Did the bookmark say you'll die sooner? No. What did it say? You'll be worse at sports. Your teeth will look gross. You'll get acne, whatever.

All stuff which is quite frankly pretty trivial relative to dying younger. But they knew the kids wouldn't care. So they focused on bringing the cost to short run. And the fact that A, we know we have to do that means that these problems are real, and B, it dramatically changes things by introducing the concept of what I labeled internalities.

In my work with Botond Koszegi, we set up a new literature discussing all these things called internalities, which are the damage you do to yourself through behavior which is not captured by the standard model.

So we ignored the whole you smoking thing. Put that aside. We just didn't focus on this aspect, the fact that people have self-control problems. Now, we said that if you take this standard model-- forget the secondhand smoke. The externalities due to smoking are $0.50 a pack. Therefore, the optimal tax tau is $0.50 a pack.

If you use this model and you take a beta of 0.6, which would typically be estimated in the laboratory, the optimal tax is $10 a pack. Why does it change so much? Because smoking is really, really bad for you.

Every cigarette shortens your life by 7 minutes. If you take that estimate and you multiply it by typical values of a life-- once again, we'll cover that in chapter 8-- you get that a pack of cigarettes damage your health by about $40.

So if you're even making a small mistake, that's a huge number relative to the $0.50. So even if beta is 0.9, we estimate a nominal tax of $5, OK? Because the fact that damage of smoking-- the internal damage is so large that if any internalities matter, cigarette tax should be much higher.

Another way to put this is if you're going to argue cigarette tax should only reflect externalities, you're going to have to argue that smokers truly are making no mistakes of any kind, either irrational youth smoking decisions or self-control problems. Once you permit that a little bit, you get a huge optimal tax.

And this is the insight of our work, that basically these externalities are real. And once again, the other point is there's no Coasian solution because there's no way to perfectly stop yourself.

You can say, well, look, I'll put cigarette butts in the water. It doesn't help. You could say, for example, what if you had a bracelet that shocked you every time you went to buy cigarettes? Well, you could cut the bracelet off. You put it on yourself, you could take it off.

But what is a good device you can't avoid, at least without illegal behavior? Cigarette taxes. So cigarette taxes are essentially government-imposed self control device, because smokers are price sensitive.

The typical elasticity of demand for cigarettes is about minus 0.4. And for kids, it's close to minus 1. So basically the point is, you can't impose your own self-control because it doesn't work. But the government can impose self-control until the point where smuggling becomes a big enough deal and black market cigarettes are a big enough deal that you can't get around it.

But until you get to that point, higher cigarette taxes serve as exactly the kind of public self control tool that you need to actually fight this problem. Questions about that? Yeah, you look uncertain.

**AUDIENCE:** I have a question about cigarette taxes. Don't they tend to be regressive?

**JON GRUBER:** Great question. So remember, we're only discussing efficiency this far into the course. But you guys are all good folks. You care about equity too. And the concern is that cigarette taxes are-- the term regressive, we'll talk about this more in the tax chapter.

It's the notion that people spend a higher percentage of their income on something the poorer they are. It's not that people spend more when they're poor, it's that they spend a higher percentage of their income. And for cigarettes, that's absolutely true.

Poor people spend a much higher percentage of their income on cigarettes than rich people. And that's for two reasons. The first reason I want to discuss last time, that rich people smoking has all disappeared. It's only poor people who smoke now.

The second reason is because as a fraction of income, it's much larger. A fixed cigarette tax, a $5 pack cigarette tax means nothing to me. It means something to a poor person. So for that reason, we will say we shouldn't tax cigarettes because they're regressive. Yeah.

**AUDIENCE:** What is the current cigarette tax?

**JON GRUBER:** The current cigarette tax varies by state. But like I said, it's between about $2 and $5 depending on the state. However, my co-author and I, Botond Koszegi, we argue that's wrong.

And it's wrong once you enter this model. Because once you're in this model and recognize that the poor people who smoke might be making mistakes, then the fact-- and you also recognize poor people are much more price-elastic than rich people.

For rich people, the price elasticity is very low. For poor people, it's like minus 1. So in fact, when you raise cigarette taxes, on net poor people spend less, because so many of them quit, that overall poor person's spending on cigarettes falls.

Now, in a standard model, that wouldn't matter. But in our model, it does matter. If you actually think people are not smoking optimally, the fact that cigarettes actually cause poor people to quit is a benefit, and it's much larger for poor people to rich people. So we actually argue cigarette tax is progressive, not regressive. Yeah.

**AUDIENCE:** So I'm thinking like there are ways that people could get nicotine that are not through smoking. And some of those are more discreet, so they don't have the fire issue and they don't have the smoke break issue and they don't have a lot of those externalities. So for taxes on goods like those--

**JON GRUBER:** Yeah, this is a fascinating issue. Once again, it's amazing teaching this course for the 137 years I've taught it, which is that how things change. This is not a topic I discussed before. So in fact, let's go back to packs.

If had said to me 15 years ago, there's going to be a new thing called vaping, it's going to live in the nicotine without the tar. Now, we know tar is fundamentally health damaging. We're not quite sure about nicotine. The evidence on the health effect of nicotine isn't as clear.

I would have said awesome. Basically, if you could take a smoker and convert them from a cigarette to a vape, that's a good thing. What I would have missed is the fact that for every smoker switching, there's 10 kids who are starting vaping.

So this is a fascinating question no one's asked, which is vaping on net good or bad? And the answer is unclear because it depends on two things. It's all about costs and benefits. The benefit of introducing vaping is it lowers the damage due to smoking. The cost is it introduces damage due to nicotine to 10 extra people.

Now, we don't really know how bad nicotine addiction is. We don't really know how bad vaping is for your lungs. So we don't really know how to make that trade-off. We're pretty sure that even with potential damage to lungs with nicotine, vaping is still better than smoking.

So we're pretty sure that if literally all we did is replace smokers with vapers, we'd be better off. What we don't know is to replace every smoker with 10 vapers if we're better off or not. And that's exactly the kind of fascinating thing. That's why this literature continues to evolve and be interesting. It's exactly that kind of question. Same about ZINs and all the other stuff folks are using now, we just don't know. Good question. Yeah.

**AUDIENCE:** Because you guys are advocating the increased taxes on cigarettes, what's the barriers to increasing? Is it political?

**JON GRUBER:** Great, great question. I mean, this will be an important question to go on the lecture to talk about other health externalities, which is that basically, the barriers are really political. In fact, someone made a great point, which is 100 years ago, tobacco leaf was grown all over the country.

Today it's grown in a very small number of states, and only once it's grown in a small number of states who were willing to regulate tobacco. Basically, there was a large political constituency to not regulate smoking.

We knew starting in the 1950s it was bad for you. But we didn't really start raising cigarette taxes until the 1990s. And basically, it was just-- it's a fascinating issue of what finally led to the change.

How did things really turn around? And this is actually-- there's so many things we could follow up on but don't have time for. This actually raises a great question. We don't have a course at MIT in law and economics anymore, but we should.

Great question of what's the optimal role of the legal system. What's the optimal role of the legal system in terms of the other economic outcomes? So for years, we couldn't deal with the externalities of cigarettes politically.

Then what happened? This US states came op with a clever strategy. The US states said, look, smoking is costing us a lot of money. We are going to sue the tobacco companies for an enormous amount of money to make them pay back what they're costing us.

Tobacco companies suddenly faced a massive potential risk. And then they negotiated a deal where they would agree to a voluntary tax, essentially, in return for ending these lawsuits. Now, I'm not a fan of a lot of the legal system and some of the excessive lawsuits we have. But here's an example where the legal system got a political process unstuck.

Once they started that, then states started saying, oh wow, now we can start raising our taxes. The federal government raised the taxes. So it started this dynamic effect. Oops. It started this dynamic effect, where basically it became OK politically to start going after cigarettes. Yes.

**AUDIENCE:** By a voluntary tax, that just meant like their lobbyists took the foot off the gas a little bit, or that they just started handing money over to the states?

**JON GRUBER:** Great question. So if I said to you as students in this class, why should we raise the price? If I said to you, we're going to raise the price of cigarettes, you should say-- well, according to what I taught you-- great. And you shouldn't really care how it happens.

But there's two different ways to make it happen. One way to make it happen is a tax. That has the advantage of raising revenues. It also has the advantage that it potentially punishes the companies.

The other is just to say, well, companies are going to have a coordinated price rise among all the companies. That has the same effect as a tax, but only if anything increases their profits, since smoking is inelastic, is relatively inelastic.

So the public health community was not necessarily crazy about this, because they wanted to not just stop smoking, but to punish the tobacco companies. If you're just about public health, we just care what the prices are higher. So I don't really care how it happened. Yeah.

**AUDIENCE:** Was there any question about antitrust talk surrounding that?

**JON GRUBER:** I mean, we're not going to talk a lot about imperfect markets and oligopolies here. But obviously, it was effectively a coordinated price increase, but not in actuality. OK? Other questions, comments?

OK. So that's how we think about-- that's how we think about smoking. Now, let's go on with that framework and talk about the other health externalities we deal with in our society. Another big one is alcohol consumption or drinking. OK?

Alcohol consumption has massive negative external effects on society. The numbers are really astonishing. These are out of date. But every day, 30 people in the US die in a motor vehicle crash that involves an alcohol-impaired driver. This amounts to one death every 48 minutes.

10,000 people a year are killed in alcohol crashes. Alcohol-related car crashes are about one third of all car crashes in this country. The estimates are that the external costs of drinking just from driving alone are about $250 billion a year, just from drunk driving alone.

And that's a massive underestimate, because it turns out, alcohol is also incredibly associated with criminal activities and abuse. Estimates suggest that much criminal activity is committed while people are inebriated, and a lot of spousal abuse is committed on people inebriated.

There's very clever studies showing that when alcohol is harder to get, crime goes down and spousal abuse goes down. These are also external. I mean, once again, unless it's a family utility function. I won't get into that. That's dangerous. But I think we can assume spousal abuse is bad. We can certainly see crime as negative externalities.

So as a result, they're basically-- and in particular, there's this really interesting study in India, which found that when they prohibited alcohol in one state, there was a massive decline in violence against women in that state.

There's another. And so basically, the externalities are huge. So unlike smoking, which has relatively modest externalities, alcohol has huge externalities. Indeed, if you perform those externalities, the optimal tax on alcohol should be roughly four times what it is today.

Guys, alcohol is super cheap. It's not sort of nuts that alcohol is less than bottled water. A can of beer is less than a bottle of water. So basically, we have alcohol should be taxed much higher.

Now, what about the externalities? And by the way, that's something Chicago economists couldn't argue with. They argue the measurement. But the bottom line is all economists agree that we should tax externality-producing activities. OK?

We all agree that externalities are large, alcohol taxes should be higher. But what about the internalities? Well here, traditionally when I taught this course, I said well, this is sort of the flip of smoking. The internalities of alcohol aren't that bad.

But in fact, there's a lot of evidence suggesting that the internalities are huge, too-- that there's huge negative underappreciated health effects on people of drinking. We've basically debunked the myth at this point that a little drinking is good for you. We've now basically found that no drinking is good for you. It's like cigarettes. Basically, no amount of drinking is good for you.

Now, it's not like I said, that every cigarette's bad for you. Probably modest drinking is not bad for you, but it's not good for you. And serious drinking causes enormous health consequences later in life.

And by the same internalities model I talked about a few minutes ago, if people are not incorporating those, that's putting costs on them. And as a result, those internalities should be added as well when thinking about an optimal tax.

But here's the trick with alcohol. Here's why it's harder. Smoking is the easiest case to start with because it's basically linear. Every cigarette you smoke shortens your life by 7 minutes in a roughly linear fashion.

Alcohol is harder because basically the damage is much more concentrated. Most drinking is done by people who don't create damage to themselves or society. The vast majority of alcohol consumption is done by people who won't be driving and won't commit crimes or abuse their spouses. They're just having a good time or whatever. OK?

So that raises an interesting difficulty, which is, well, gee, if I'm going to tax alcohol-- if I tax cigarettes, every cigarette's bad. It's clear I should tax cigarettes. With alcohol, should I really tax it when most people and most alcohol consumption is not actually damaging? OK?

And the answer here is in a perfect world, we would use other tools. For example, a perfect world, we would try to use tools other than taxes which could target the high-- so in a perfect world, for example, you'd only tax people who bought more than a certain amount of alcohol per day. OK?

That's impossible, because you can always send someone to buy for you. In a perfect world, we would actually target the tax to those doing damage. We can't. OK? We also could use other tools like penalties on drunk driving.

Indeed, penalties on drunk driving are pretty bad. You guys really should not drive drunk. By the time you get your second DUI, busted for driving twice, I'm informed-- not personal experience-- I'm informed that by someone who got their second DUI, that by that time, they lost the license for three years and paid $50,000 in legal bills.

So they're extreme, but it's apparently not extreme enough, because we're having a lot of people dying in drunk driving accidents. So this is where we get into what the economists would call the theory of the second best.

The theory of the second best is the notion that, well, the ideal would be let's just tax the guys causing the damage. If we can't do that, should we resort to no taxes or some tax on everyone? And the answer is, some tax on everyone.

And the reason is because the disutility to a modest drinker from a tax is small relative to the benefit of reducing excessive drinking. So it's not as good as just taxing excessive drinking. But the benefits of excessive drinking exceed the disutility.

Because remember, deadweight loss are small near the optimum. Think about a small alcohol tax. If you're drinking and not causing damage, that small alcohol tax will not cause much deadweight loss. If you're drinking and causing a lot of damage, that small alcohol tax could reduce that damage and really reduce that deadweight loss wedge.

So by that logic, we always want some alcohol tax. The question, how big can it be before the damage to those who aren't causing cost to society exceed the benefits of reducing excessive drinking? OK, questions about that?

All right. Cigarettes are easy. Drinking is harder. Now let's talk about illicit drugs. This is a real challenging case. And why is this a challenging case? It's a challenging case because here, the externalities largely arise from the illegality itself.

Think about it. Why do drugs cause externalities? They cause crime because people are trying to pay for the expensive drugs, or the criminal market. If drugs were legal, that wouldn't exist.

They'd be cheap because they'd be able to flow freely in and out of the country. And there wouldn't be criminal activity associated with them. So in fact, the biggest externalities of drugs would go away if they were legal.

And that's why for years, economists have argued for legalizing drugs. By and large, they've said, look, the externality argument cannot justify illegal drugs. In fact, it's pretty hard to justify illegal anything under externalities.

The economists say if it's really an externality problem, we should basically make them legal and tax them. But the question is, are the internalities especially large here, because of the addictiveness combined with the extreme consequences of mistakes?

If I make a mistake and start smoking and I'm unable to quit, I will live seven years less on average. But if I make a mistake and get hooked on heroin or fentanyl, I could die 60 years less. I could die tomorrow.

So since the consequences are more extreme, people are more worried about considering internalities. This comes up with the only political issue my wife and I have ever had a fundamental disagreement, which is the legalization of marijuana.

She felt marijuana shouldn't be legalized because it's bad for people. I said basically, no, the externalities of marijuana are due to the illegality. There's no evidence it's that bad for people. We should legalize it.

Now, it has been legalized in a number of states, as we know. The evidence so far is that certainly marijuana-related crime is way down. It's not illegal anymore. Overall, traffic deaths are not worse.

Although it's a cool study by one of my students showing that traffic deaths go up a lot around dispensaries. And so overall traffic death numbers, they go up a lot around dispensaries. There is much, much more marijuana consumption. But it looks like most of that is among adults, not kids.

So far, I would say the evidence of legalization is fairly positive, but the jury's still out. This is the kind of thing-- in a perfect world, once again, a lot of the policies we talk about where we need evidence, we'd put it temporarily.

It's going to be hard to put this genie back in the bottle if we decide marijuana legalization is bad. It's going to be hard to deal with that. We're never banning alcohol or cigarettes. So the question is, how do we feel about that?

And then in particular, if marijuana should be legal, what else should it be? And how do we think about these trade-offs? And basically, it really comes down to a lot of the fact that people are really worried about these internal damages people do for the more serious drugs.

Now, of course, the biggest drug problem in our country today is opioids, and currently the fentanyl crisis. Here's a fascinating case where public policy backfired. What happened? What happened was in this country before the 21st century, we used to systematically undertreat pain.

If someone came in and was in pain, we basically ignored them. There was a realization we were doing that and it was bad for people at the same time as this miraculous new drug called OxyContin was invented.

Doctors knew for 150 years that opioids were addictive and bad for you. So doctors didn't treat pain with opioids because people would be addicted. OxyContin came along and said, we have a new formulation that's slow release, so you won't get addicted. And there's even a *New England Journal of Medicine* article to prove it.

Well, it turns out the *New England Journal of Medicine* article, much like our case with our autism article, was some letter written by some guy who treated 10 guys at a hospital in Boston and said they didn't get addicted, so OxyContin's OK.

But that was enough for Purdue Pharma to go to the doctors. And the doctors said, look, well geez, I'd love to make people's pain go away. If you're telling me it's non-addictive and I can make people's pain go away, let's do it. And OxyContin exploded.

The problem is, OxyContin was overused and prone to abuse, which is you could crack the pills in half and snort it. And it gave you real high and became abused. So once we started realizing more people were dying from drug overdoses-- and we see this.

You can actually see this if you look at figure 6-6. This shows deaths of car crashes, deaths from overdoses. I remember the first time I saw this graph in 2010. I couldn't believe it.

Starting in about 2008, you see the deaths from overdoses starts to exceed deaths of car crashes. That was exceptional to think that there were more overdose deaths than-- and it continues to go up.

So that basically you had a situation where there was excessive deaths from this. So the government realizes that we have to end this abuse. We have to really create an abuse-deterrent formulation of OxyContin where you couldn't crack it in half. That was a well-intentioned public policy.

What was the problem? The problem was you had hundreds of thousands to millions of people addicted to opioids. They said, fine, we can't get OxyContin. We'll go to the next thing, which is heroin to meet our fix. The problem is heroin really kills you. And then from there, they went to fentanyl, which really, really kills you.

So the problem is we created this addiction. And in trying to fight one aspect, we shifted people onto a more dangerous substance. And you see the incredible peak in the number of people who die from overdose deaths, reaching more than 100,000 people a year. More than 100,000 a year, basically all caused in many ways because of this initial prescription drug.

And that raises-- we talked in the first lecture about the role of the FDA-regulated drugs. This is the kind of challenge we face in our society. Once again, this is why we have to constantly-- I talk about a well-meaning, well-functioning government in this class. But that's why we have to constantly be vigilant about the consequence of the government's actions. Yeah.

**AUDIENCE:** I think it was that-- I'm not completely familiar-- but I think that the doctors had to prescribe the opioid, and then couldn't the doctors say if they knew it was bad, that you don't have to take-- you don't have to get the prescription filled? Would that be--

**JON GRUBER:** Yeah, I mean, there was a lot of-- I was involved with some legal cases with opioids. There's a lot of-- it's unclear who the bad guy is. There's a lot of bad guys here. Purdue Pharma is really bad. They pushed it too much.

The doctors, some doctors were trying to do right by their patients, saying, you're in pain. I'm going to help you. Some were not. Some were like, great, I prescribe this and make a lot of money. I'm just going to prescribe it and you don't have to take it. Some doctors went worse and literally were making a prescription for what they call pill mills. But there's a lot of blame to go around here. Other questions? Yeah.

**AUDIENCE:** What about policy that perhaps would stop health insurance companies from paying for opioids?

**JON GRUBER:** Well, I mean, once again, delivered appropriately, we wouldn't want that. Opioids are miraculous post-surgery. It's a simple policy, which is they should have sent you home with-- when you get a surgery now, they send you home with 10 pills. They send you home with 30 and a refill for six months.

So it's not that hard to change. It's just it was in no one's financial interest to change it. So that's why these lawsuits are targeting everyone around the chain, because everyone was bad. Like the distributors, they're the people who distributed the drugs to stores.

They should have noticed that there were areas in Florida where stores were wearing 10,000 pills a day in little communities in Florida. They should know, wait a second, there's no way people need 10,000 OxyContins a day in podunk Florida. But they let it go because they were making money, et cetera. OK?

Now, that is all child's play compared to the hardest one of these at all and the number one public policy issue, probably in the-- public health issue probably in the world today, which is obesity.

Obesity is a really hard problem because obesity is incredibly difficult. Obesity is typically defined as having a body mass index which is ratio of weight to height above a certain level-- ratio of height to weight, a function of that above a certain level.

The share of Americans who are obese rose from 13% in 1960 to 45% today. 45% of Americans are obese. Now, you might hear that number and say, that sounds strange to me. And indeed, it should. I have not taught an obese student in at least 15 years.

I teach a lot of students. OK? Obesity, much like smoking, has been concentrated in certain segments of the population. The achievement-focused segment of the population-- how many of you guys drink either Diet Coke or Coke or any soda product? Don't be shy. I do all the time. OK? This is amazing.

I remember the first time I asked that question about Coke Zero in class and I thought I'd take a survey of Coke Zero versus Diet Coke. I said, how many of you guys drink Coke Zero? 10% raised their hand. How many drink Diet Coke? 10% raise their hand.

I'm like, what about the rest of you? They were like, we don't drink soda. And I'm like, what the fuck? You don't drink soda? What do you mean? And it's just a health-conscious thing. You're more health conscious. They drink a lot of soda in America. Soda industry is doing fine, just not you guys.

Obesity is a major, major problem in this nation. And not just in this nation. There are about on the order of almost 1 billion adults worldwide who are obese. And fundamentally, the problem in the world is moving from hunger to obesity.

Fundamentally, we've conquered hunger, and the problem is obesity. Now, why is that happening? Well really, it's two things. The first and less important part is the decline in physical activity.

As someone said once-- I love this-- we used to get paid to work out. Now we have to pay to work out. We're fundamentally not active anymore, and therefore not getting physical activity. But that's less important than the second factor, which is the availability of cheap and easy-to-prepare but bad-for-you foods.

Preparing a dinner used to be a major time-consuming undertaking that involved healthy ingredients. Now it's Doritos, which are cheap and quickly available. It is astonishing how much more expensive fruits and vegetables are than things that are bad for you.

And as a result, there's relative price incentives to eat badly. And that's what's also caused the obesity. OK? This has caused obesity. This has an enormous external consequence, which is the rise in diabetes. Or as my daughter said to me, "diabeetus", from that meme from many years ago.

From diabetes, which is a progressive, chronic disease that's incurable, that is now affecting about 10.5% of the US population is diabetic. About one third of the US population is pre-diabetic, which means they're at risk of diabetes.

That's incredible. Basically, every child born today, one out of three will develop diabetes. OK? That's an astonishing rate. And that is enormous consequence, both external and internal. The US spends about $350 billion a year on obesity-related costs.

And if someone's obese, it shortens their life span by an average of about four years. So we're talking about 40% of Americans are shortening their lifespan an average of four years. That is astonishing. This is an enormous, enormous problem that we're facing worldwide.

The problem is, this is really hard to deal with, because remember I talked about, smoking is easy. Every cigarette is bad for you. Alcohol is harder because for a while, it's not bad, and then it's bad for you. Eating is really good for you until it isn't.

So you don't want to stop people from eating. We'd be great if you stopped people from smoking, actually not terrible if you stopped people from drinking, but really bad if you stopped people from eating. So it's a way harder problem to deal with, because once again, nonlinear taxes are really hard. It's hard to tax heavy eating and not non-heavy eating.

So what do we do about that? Well, there's a number of public policy tools that have been introduced to try to deal with the obesity problem. The first is to try to change the nature of the food supply. And the term you'll often hear is food deserts. These are areas where there's bad food available, but not good food.

The evidence on that is kind of mixed. There's some evidence that if you live closer to fast food, you're in worse health. But basically, the easy availability of fast food puts you in worse health.

But there's unfortunately no evidence that living closer to good food makes you healthier, probably because it's just too damn expensive. So when you solve these food deserts, it doesn't make people healthier. That solution by itself isn't really working.

Another approach is to tax unhealthy foods. In particular, there's a lot of interest now in soda taxes. A major source of obesity in the US is sugar sodas. It's a major source of obesity. And basically the idea is-- and soft drink consumption increased by 300% from 1998 to 2008. Now, I don't know what's happened recently. I should update that.

Now, there is a number of cities in the US-- Philly, Berkeley, other cities-- that put in sugary soda taxes and put in taxes on sodas to try to reduce soda consumption. And they are working to some extent. They're not a huge effect. There's no real good evidence yet that they're significantly affecting body weight.

They do seem to be deterring soda consumption to some extent, but not really lowering body weight. Now, other countries are more aggressive. Mexico is taxing sugar-- all sugar products. I've worked on diabetes in Mexico.

Mexico has the world's worst diabetes problem. Mexico spends something like-- it's something like 1.5% of their entire GDP just dealing with the complications of diabetes. And it's partly biological, the makeup of the citizens. It's also their diets.

So Mexico put a sugar tax on all sugars, not just on sodas, but on other things. So that's one approach. But the problem with that is it doesn't get all the causes of obesity and people can substitute.

Fat's really bad for you too. You tax sugar, people switch to fat. Tax fat, they switch to sugar. Tax both, they switch to something else. So it's a really hard problem to deal with just by taxes. Probably the least amenable to taxes among these problems.

A third approach is more information, explaining to people how bad certain things are for you. Indeed, I knew someone who was a partner of Dunkin' Donuts. And he told me that when they put calorie information on Dunkin' Donuts, donut consumption did not change at all, but muffin consumption fell through the floor, because everybody thought muffins were OK. Turns out they're worse than donuts. Who knew?

So basically, information can help. And there's studies of what happens. The Affordable Care Act actually included a requirement that large restaurants include calorie information on their menus. And studies that have shown that it has impacted eating habits modestly, that information can help. Just once again, the effect is modest.

Now finally, what may be most effective in battling obesity is thinking about self-control strategies. Can we actually engage with self-control problems people face? And here, there is an enormous amount of literature which suggests that small behavioral interventions can actually massively change how people eat.

So for example, my favorite study in this area is they took people who were going to a movie who'd all eaten lunch at the same time, and they gave them buckets of stale popcorn of different sizes-- small, medium, large.

Basically, the bigger bucket of stale popcorn, the more they ate. Even though they thought they were equally full and the popcorn was stale, if you put more in front of them, they eat more. OK? Another fun study someone did up at Dartmouth.

So when you go to buffet, you walk down the buffet, pick what you like. And it turns out, at a typical buffet, about 15% of food is wasted. Because by the time you get to the end, like oh, I didn't know this was going to be here, or I already over-- I'm going to pile it on the edge of my plate. You don't eat it.

So someone switched a buffet so the plates were at the end rather than the beginning, and consumption from the buffet went down 15%. Because you walk by and you're like, oh, that's going to be there. I know I shouldn't take so much at the beginning.

These sorts of behavioral interventions can be very effective. And so that's another tool we can use. OK? Finally, we have perhaps what's the ultimate tool, which you say, look, what really is the damage that's done here-- the damage that's done here is really done by excessive body weight. So why don't we just tax that?

We'll have a skinny subsidy. We can subsidize people to be skinny. Now, obviously I'm not running for office. That would be clearly a dramatic challenge. But it's also not obviously a great policy-- not obviously the right policy. Why is that?

If the problem is self-control, then basically how are you going to deal with it by something that taxes people are going to pay in 15 months? So it's January, and next April I'm going to pay a higher tax because I got fat. I'm not going to focus on that. I'm focused on what's in front of me.

So it's also not obviously the right policy in terms of if the problem is self-control. The bottom line is obesity is the single hardest of all these problems to deal with. The answer is probably a broad combination of all these policies need to be put in place to deal with it. But it's really the fundamental public health challenge of our time. OK? Questions about that? Yeah.

**AUDIENCE:** You said exercising [INAUDIBLE] exercise now before we have it. Is there thoughts on subsidizing exercise in some way?

**JON GRUBER:** Well, I mean, the trick with exercising is it's way less effective than lowering eating So basically, roughly speaking, walking for an hour is kind of like a muffin and a donut. So that's a lot of exercise. And it's not that much food that you're offsetting.

So basically, exercise is harder. There's a lot of policies. So one thing the Affordable Care Act did is it allowed companies to actually value your health insurance premium by your participation in things like exercise programs.

So there are now financial incentives to exercise and get people to commit. And that's clearly going to help. Basically, there's no magic bullet here. We're going to have to keep trying all these different approaches. Yeah.

**AUDIENCE:** What about the weight loss drugs like Ozempic?

**JON GRUBER:** Ah, great. Excellent point. I actually have an editorial on the *New York Times* that I published a few weeks ago about this drug. So we're going to talk about the incredibly new miraculous drugs we're developing in this country. This is one of them.

We'll talk about all this when we talk about health care. This is an incredible drug. Now, we don't quite know how it works. But basically, if you talk to people on it, it essentially makes you feel satiated.

In the past, we've tried to fight obesity with chemical interventions. We've done so in a way that makes you unhappy. This doesn't make-- feels like, meh, I just don't want it anymore. That's great. It basically works on the margin. We talked about the margin we need and want.

Basically, it used to be that basically other drugs would effect both need and want. This would effects want, but not need. So basically, it's incredible. It also looks like-- there's early evidence that may affect other socially undesirable behaviors like excessive drinking and gambling and things like that.

So it seems like something that's a really miraculous drug. It's also $15,000 and you have to be on it forever. So my coauthors and I estimated that if every obese person in the US was made eligible for Ozempic and the government paid for it, it would cost the government $800 billion every single year, which is the size of the Medicare program we'll talk about later.

That said, Ozempic is now in these-- the GLP-1s are now underused, quite frankly. Because they're so expensive, they're only prescribed for certain very well-targeted cases. Here's a great example. You can get Ozempic if you're diabetic.

Well, if you're diabetic, it's sort of already too late. I mean, it's great to control your weight. But the truth is, the guys who aren't yet diabetic are who we really want on these drugs and they can't get them.

So in some sense, these drugs are underused. On the other hand, they're really expensive. And this is something we'll talk a lot about when we talk about health care, which is drug price regulation. Yeah.

**AUDIENCE:** I'm just curious. So with [INAUDIBLE], how much would the government save if you subsidized for every obese patient in the US?

**JON GRUBER:** If you subsidized?

**AUDIENCE:** These drugs--

**JON GRUBER:** No, no, no, this is the thing. That includes the cost. This is what was said in the article, which is that everybody's like-- so the CEO of Novo Nordisk said, this is a great deal, $15,000, because it saves money down the road. He's wrong.

Basically, if everyone was obese, this drug would cost us a trillion and we'd save $200 billion for a net of $800 billion. So if the drug was cheap enough, it could pay for itself, but nowhere near the current price. Yeah.

**AUDIENCE:** How do you reconcile that some individuals who are obese may have preferences or choices from before they're 18 years old?

**JON GRUBER:** It's a great question, which this is in some sense one of the most fascinating things we had to deal with in health care reform, was the line between self-control and lack of control. So when we passed the Affordable Care Act, part of what we did is we made health insurance communal. We got everybody health insurance.

And every email that didn't contain a swear that I got was about, why should I pay more for my fat neighbor? Why should I pay more? And the answer is, well, because maybe your fat neighbor is fat for reasons they couldn't control. But if that neighbor's fat because they just ate a lot, maybe we do want to think about how much we want to subsidize that.

So that's a really interesting question, of how you address sin behaviors is how do you think about biological propensities versus bad behaviors is really hard. It's a hard question. Yeah.

**AUDIENCE:** Michelle Obama's, I don't know, crusade against lunches--

**JON GRUBER:** I don't think she was against lunches.

**AUDIENCE:** Oh, yeah. I know that was a talking point probably about a decade ago. Yeah. I'm older, I guess. Do we have any evidence that was effective or not effective? Or if that did anything?

**JON GRUBER:** No, we don't know. I mean, I don't think public good interest campaigns really moved the needle. I think she had a campaign against poor eating, against poor nutrition. I think to move the needle until we move it massively.

That was the thing with smoking, which is we had these things going, going, going. All of a sudden, boom, it became OK to be against smoking, and things changed overnight. So it's maybe building a movement that eventually matters, but it hasn't moved the needle so far. Yeah.

**AUDIENCE:** I was wondering, wouldn't it be more effective if health insurance companies would pay for, I guess, groceries and exercise versus--

**JON GRUBER:** Great question. This is actually a big movement in health care is what's called the social terms of health movement, which is actually having health insurance plans pay for your food, your housing, all these things which ultimately affect your health. Quite frankly, probably more than health insurance. I hate to say it as a health economist.

But look, the truth is, where you live and what you eat and whether you get shot probably matters a whole lot more for your health than what health insurance plan you have. The problem is, for a health insurance perspective, it only makes sense to pay for it if it's actually going to save them money.

So it's very important to distinguish two things-- and we'll come back to this-- cost saving versus cost effective. If I took every one of you today and sent you to the doctor, that would probably be cost effective, in the sense that the doctor's visit-- we'd probably find one or two of you something wrong that you wouldn't have found otherwise.

Nope, don't worry. Wouldn't have found otherwise. And that would be good to find it. But you probably on net would still spend more on all the doctors than finding the one or two things that are wrong. So it wouldn't be cost saving, but it might be cost effective.

It might be a good thing to do in terms of the value of your health, but it wouldn't be cost saving. And the question of social determinants, I they're pretty clearly about cost savings. The question is if it's cost effective. The insurance companies aren't going to do them. The government would have to subsidize. Yeah.

**AUDIENCE:** How is this different from alcohol? Like you said--

**JON GRUBER:** It's different alcohol in a number of senses. One sense is, remember, alcohol is never good for you. Now, people enjoy it, but it's never good for you. Eating is good for you. So you've got this nonmonotonicity that you don't have with alcohol. That's point one.

Point two is, with alcohol, I think the externalities are enormous. And obviously, the internalities are a little tougher, are less obvious here. There's obvious externalities and internalities. And the third thing is with alcohol, we pretty much know how to fix it, which is a higher tax-- fix it or know how to address it. A higher tax would address it. Whereas here, higher taxes don't solve the problem. Yeah.

**AUDIENCE:** With the way SNAP, EBT are structured, the amount of money for food, is that limit-- the limited amount of cash-- also pushing people to the cheapest possible option?

**JON GRUBER:** It's a really interesting question. We'll come back and talk about SNAP. That's what we used to call food stamps, which are subsidies for-- it's what you're talking about, right?

**AUDIENCE:** Yeah.

**JON GRUBER:** Which are basically-- we'll talk in chapter 17 about how we distribute sometimes in cash, sometimes in goods. And one form of goods is to give people essentially debit cards that they can use to buy food cheaply at the supermarket. And the question is, well gee, should those debit cards, for example, only be usable for healthy food?

That comes to the fundamental question of paternalism that we'll talk about in chapter 17, which is to what extent is the government going to be paternalistic about what you use your money for? And that's a hard question. Yeah.

**AUDIENCE:** With alcohol, the whole reason that it is parabolic is the sense that if you drink a little, it gives you a lot of social benefits, such as you would socialize with friends.

**JON GRUBER:** Well, the question is, though, is that internal or external? I'm saying the externalities are not nonmonotonic. Now, you're right, there could be some nonmonotonic externalities if basically we have social anxiety and alcohol is the way we fight our social anxiety.

But then there's a question of why would we want-- wouldn't we want our better tools for fighting social anxiety than getting drunk? I'm often fascinated. I play with kids like my little niece and nephew. And it's super fun.

And why are little kids fun? Because the don't have social anxiety, they're just having fun. Then somehow we hit puberty and we all become shy and unable-- unless we're drunk. And then we're like kids again. So aren't there better ways that we could get people to fight their social anxiety than getting drunk?

All right. OK, that's all I want to say about chapter 6. We're going to turn now and start chapter 7 on public goods. Remember that this section of the class, we're talking about externalities on public goods.

Now, what's tricky about public goods is they're related but somewhat subtly different than externalities. And to think about that, let's think about two aspects along which goods can differ. You should have a chapter 7 handout as well.

The same handout as the chapter 7. Look at table 7-1. Let's think about two aspects of goods we want to focus on. The first is rivalry and the second is excludability. Rivalry is whether my consumption of the good interferes with your consumption of the good.

So if I have the good, does that deter your enjoyment of the good? Excludability is, can I stop you from having the good? A pure private good is one which is both rival and excludable, like ice cream.

If I have ice cream, you enjoy it less because there's less there for you. And I could just not sell you ice cream. It's rivalrous if every bite I take is one less bite for you. And it's excludable if I can just not sell it to you. That is a pure private good.

A pure public good is a good which is neither rival nor excludable, the ultimate example being national defense. If a missile is protecting me, it doesn't deter the missile from protecting you. There's no sense in which having a missile protecting an area is rival.

Once somebody is protected, everybody is protected. And it's not excludable. You can't say the missile can protect your house, but not your house. OK, national defense is an example of a pure public good.

But we also have what we call impure public goods. So for example, things which are rival but not excludable, like, say, a crowded city sidewalk. A crowded city sidewalk, it's rival. When I'm on the sidewalk, I interview if your enjoyment of the sidewalk because I'm getting in the way.

But you can't not let me on the sidewalk. That is rival, not excludable. We have goods that are excludable but not rival, the best being TV streaming, which is to first approximation if my neighbor and I both stream, it does not rival. At some point, the load gets high enough, it's rival. But it's generally not rival.

But the cable company is not just delivered to my neighbor's house. It's delivered to my house. So that's another kind of impure public good. So we basically have these different kinds of public and private goods. And it turns out that there's a very different implication for optimality when talk about purely public and purely private goods. So to do this, let's go back. Yeah.

**AUDIENCE:** Satellite would fall under purely public though, right?

**JON GRUBER:** A satellite?

**AUDIENCE:** Like satellite television, where--

**JON GRUBER:** It's excludable.

**AUDIENCE:** Or what's the one where it's just around, and if you have a receiver, you can pick it up because it's in the air?

**JON GRUBER:** I mean, I guess in some sense, nothing, right? I mean, basically-- I guess ham radio or whatever. Yeah, anything like that would be pure public good. That's right. OK, so to do this, what I want to do is I want to go back and review a little bit our theory of pure private goods.

And then what I'm going to do is go on and talk about pure public goods. So to review this, let's look at figure 7. Let's look at figure 7-1, OK? And let's imagine two goods, Ben and Jerry-- two people, Ben and Jerry.

And Ben and Jerry are deciding between two private goods, ice cream and ice cream cones. No, I should say-- oh, ice cream cones and cookies. OK, I'm looking at the wrong-- one second. Sorry about that. Ice cream cones and cookies.

And basically, they're deciding between consuming these two pure private goods. They have a certain budget. And they can spend that on ice cream cones or on cookies. And for simplicity, we're going to assume that the price of cookies is $1.

Remember, we're talking about this modeling trick called the numeraire good. We'll assume the price of cookies is $1. So in this world, given their budget, as we derive in chapter 2 and derived in 14.01, you can derive a demand curve for ice cream.

Given a budget, given a utility function, you can have a demand curve for ice cream. That demand curve for ice cream is shown for Ben in panel A and for Jerry in panel B. So Ben's demand for ice cream is such that at a price of $2, he wants two ice cream cones. OK?

Jerry likes ice cream less. At a price of $2, he only wants one ice cream cone. And they're well-defined demand curves for ice cream. Now, what is the market demand for ice cream? Well, the market demand curve for ice cream is just the sum of Ben and Jerry's demand.

The market demand is the sum of Ben and Jerry's demand. That's in panel C. In aggregate, if you charge a price of $2, there's three ice cream cones demanded. And assuming no externalities, that is the social marginal benefit of ice cream in this two-person society.

Assume there's some social marginal cost of producing ice cream. Where they intersect is the optimal quantity of ice cream. That's the first best, the social welfare maximizing optimum, assuming no externalities, would be to produce three ice cream cones at a price of $2. That would be the first best.

OK, now, let's actually write this down mathematically. If we recall from chapter 2, the optimality condition for a private good would be that the marginal utility of Ben for ice cream over the marginal utility of Ben for cookies is going to be equal to the marginal rate of substitution for Ben-- the marginal rate of substitution between ice cream and cookies.

It's the marginal rate of substitution for ice cream and cookies. Ice cream and cookies. It's the ratio of marginal utilities. Now, in equilibrium, since everyone is in equilibrium, that is then equal at the optimality to the price ratio of ice cream to cookies.

That's the optimality condition derived in 14.01. Moreover, since there's good equilibrium, we also know that it's equal to people to Jerry's marginal rate of substitution between ice cream and cookies.

Because if Ben and Jerry had different marginal substitution, they should shift their consumption to the marginal rate of substitution or equal to the price ratio. So the marginal rate of substitution for Jerry must deal the marginal rate of substitution for Ben in equilibrium. And they're both equal to that market price ratio. And that's the social welfare optimum.

We also know that on the production side, firms will produce until the marginal cost of producing ice cream relative to the marginal cost of producing cookies is equal to the price of ice cream over the price of cookies. That's the supply side condition. That's what firms are going to optimize.

So basically, if we are going to assume that the price of cookies is $1-- OK, let's assume the marginal cost of cookies is also $1-- we can safely say the marginal cost of ice cream is equal to the price of ice cream. We're just turning ratios into levels by using numeraire goods.

So basically, the marginal cost of ice cream and the price of ice cream says this is $1. That means the marginal cost of ice cream is equal to the marginal rate of substitution between ice cream and cookies. And that's the equilibrium.

We know the price ratio is equal to marginal rate of substitution. Since we assume the price of a cookie is $1, that means the price level is equal to the marginal rate of substitution. So price ratio is equal to the marginal rate of substitution.

And that is the equilibrium condition in a private market. Questions about that? Once again, I'm going fast. But I'm assuming you guys all know this from chapter 2. OK? Questions about that?

Now, imagine we change the problem in a small way, which is we're now choosing between missiles and cookies. OK, no more ice cream and cookies. Ben and Jerry got militaristic and are now choosing between missiles and cookies.

So the difference between missiles and ice cream cones is that missiles are public goods. They're non-rival and non-excludable. So now how does that change the problem? OK, let's look at figure 7-2.

The difference is now when we choose a quantity of missiles, we do not choose them individually. We not choose each person's number of missiles like we choose each person's number of ice cream cones. We choose a number of missiles-- a socially optimal number of missiles.

And so what we now have here is that we have each individual's demand for missiles, which is essentially-- remember, what's the demand curve? it's a willingness to pay curve. So we can graph each individual's willingness to pay for missiles.

So take Ben. Ben is willing to pay $2 for one missile and $1 for five missiles. OK? It's a downward-sloping demand curve. So for the first missile, he's going to pay $2. But then demand is diminishing, because one missile is going to protect him pretty well. For a second missile-- if you want to buy-- then its demand is downwards, is diminishing. OK?

Jerry, on the other hand, is a real militaristic guy. Jerry is willing to pay $4 for the first missile. Even by the fifth missile, he's still willing to pay $2. So that is their underlying willingness to pay, which is a virtual demand curve.

The willingness to pay and demand are symmetric. What does that mean? That means that society's willingness to pay is the vertical sum-- not the horizontal sum, as in the previous case-- but the vertical sum of the individual's willingness to pay.

So society-- remember, Ben was willing to pay $2 for the first missile. Jerry's willing to pay $4 for the first missile. So society is willing to pay $6 for the first missile. Why? Because the missile benefits them both equally.

Unlike the ice cream cone, ice cream cone Ben gets and Jerry doesn't get. Now if Ben gets the missile, Jerry gets the missile. It's a public good. So if Ben's willing to pay $3 to get protected and Jerry's willing to pay $4 to get protected, society is willing to pay $6. Remember, society is the sum of these two guys.

OK, so that vertical sum shows the social marginal benefit for missiles is the vertical sum of these lines. Then if there's some social marginal cost curve of producing missiles, you get an equilibrium, in this case, which is five missiles we produce at a price of $3. Questions about that?

Let's do this mathematically. Mathematically, the difference is now, what is the marginal-- what is the slope? What is the marginal rate of substitution for society? What's the social marginal benefit? Well, it's the sum of Ben and Jerry's marginal rates of substitution.

So now the social marginal benefit of missiles is equal to the marginal rate of substitution of Ben plus the marginal rate of substitution of Jerry. That's the social marginal benefit of missiles.

But the social marginal cost is just the same as it was in the private market. It's the marginal costs of producing a missile. Remember, we're seeing marginal cost of cookies is $1. So that is equal to the marginal cost of producing a missile.

So look at what the difference is here. OK? Look at the difference. It's equal to the marginal cost of producing a missile. It's the marginal rate of substitution of missiles for cookies. And this is the marginal rate of substitution for Jerry of missiles for cookies.

Note the key difference. OK? Here, we said each individual's MRS gets set equal to the marginal cost. Here, it's the sum of all MRSes which is equal to the marginal cost. Subtle, but part of why Paul Samuelson won the Nobel Prize for proving this in 1953.

That basically, the difference with the public good is since consumption is non-rival-- since multiple people will benefit for the same good, we want to produce more of it. So as a result, we want to account for the fact that since everyone benefits, we're going to sum up everybody's marginal benefit to get the social benefit and set that equal the marginal cost.

That's the difference. With ice cream, I only want to do it till my benefit is equal to the cost, because only I benefit from the ice cream. You don't get any. I ate it. With a missile, we both benefit. So we want to wait until the sum of both our benefits are equal to marginal cost.

And that's the key difference between public and private goods, is the private good you produce until an individual's benefit equals society's cost. And every individual's the same. Here, produce till the sum of society's benefits equal society's costs. OK, questions about that? A little mind blowing, so take your time on that one. Yeah.

**AUDIENCE:** Are there any assumptions that we're making in this, or is this just like--

**JON GRUBER:** This is a pretty general proof. Like, this is a general case where if you have a good that's benefiting many people, you're going to want to account for all those people's benefits in deciding how much of it to produce. That's really the insight. Yeah. Another question? Steven.

**AUDIENCE:** Yeah, in what way is the second different from saying, OK, if Ben's optimal amount of ice cream is x and Ben Jerry's is y, the sum of those is all the ice cream that's produced? Why is that quantity different from the quantity that you would get when you're just like, we know they both want a lot of ice cream and it should add up to something.

**JON GRUBER:** But the difference is if they both-- that's absolutely right. Their total demand will depend on how much they want ice cream. The difference is that if you raise the cost of ice cream, that's going to affect each of them by a certain amount.

And you only care about how much it affects each of them. Here it's going to matter how it affects their total value of the missiles. It's a little bit subtle. We'll actually come to this more next time. May become clearer when we talk about optimality. But other questions about that?

OK, why don't I stop there rather than giving you the next section? So we'll come back next time and talk about, can the private sector provide public goods efficiently? And if not, what can the public sector do? And I think you know the answer.