

EEP100 Lecture 24 (Nov 19, 2009)

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So...there's a mistake in the homework three. It's not a critical mistake. It is merely an unclarity. And correcting the mistake will make your lives easier. I already uploaded it.

On the old one (this is problem number two)...on the old one, the diagram goes like this. The way it should've gone is like this. So the...this circle of "what did Nature do" is in the wrong spot. It was right here.

*So nature moves left?*

No...the wording on it is exactly correct. Where I put the circle is wrong.

This implies, in terms of the jargon of game theory...this implies that number two doesn't know what number one did. Number two *does* know what number one did, which is one of those two moves, but then number two does not know what nature does. All the information is exactly the same as before, except now it's correct in terms of the diagram.

So whoever made that correction to Fei in section gets a point added to their course grade.

*They were just confused about it.*

They were confused about it? Then they don't. Well maybe they do; you decide. You're dictator of that point.

*So one still only has 2 options. And then nature chooses up or down.*

Right.

*And then player two...because right now it looks like player one has four choices.*

Player one does not have four choices.

*Who's making that decision that...*

This is nature. This is...nature is making this decision. One is making a decision. And then number two is making a decision not knowing what's going on. So the wording is correct. The answer is the same. The question is the same. The diagram is wrong. I'm just changing the diagram. You should've not relied on the wrong diagram. You should not have worried about that. Because if you relied on the wrong diagram, you would've made a mistake because you would've contradicted the wording. But now the correct diagram is up. Those of you in class have been warned. And those of you who are listening to this tape when it shows up on the internet will also have been warned. Okay? Good. That's due on Tuesday.

There's an organization called the Koag Foundation. They're sending out propaganda for internships in Washington D.C. I have hard copy propaganda here. This is one of those gold plated things that you get paid like \$10,000 for a summer internship. It's free market angle, if you're interested in that kind of ideology. Come and see me after class. I will send out an e-mail with all the same garbage so you can look at it. They're a very good organization. Apparently,

the Koag Company is one of the larger, if not the largest, private companies in the United States. Something like...very, very big.

They are more libertarian market oriented, so they put their money where their mouth is. And they fund internships for students and associate thingies. One-year jobs for people that are just graduated. So look into that if you want to go into the sausage machine in D.C.

Briefings. We are going to hand back the briefings next Tuesday. We've done a vast majority of the grading. There's a whole bunch of points scoring correlation averaging going on. My overall impressions, to be brief...I'll give more next week. A lot of you did a very good job. There were new ideas in there that I had not thought of before to solve collective action problems. This is exactly what I was looking for.

Congratulations for people that came up with those ideas. Unfortunately, sometimes your peers didn't recognize your genius. So you may have to wait for the Nobel Prize, and not get the points in the course, but we'll see how that works out.

I wanted to point out that sometimes a really basic idea is really important. And this is...have I showed you this bumper sticker before? No? This is my economic policy on a bumper sticker, okay?

Some water for free and pay for more. Everybody is worried about water shortages, and economists are saying, well, we should price water. So you raise the price—supply is less than demand, and then people say, “But wait! What about poor people?” and “Water's a human right!”

So you have this kind of argument between equity and efficiency. Equity meaning that everybody deserves some, and efficiency meaning...you have to price water.

And I just took a simple idea from...it's in the South African constitution, and a couple other constitutions...which is that everyone has a right to water, but a limited amount of water. It turns out to be 50 liters per capita per day in South Africa. In Las Vegas they use...I had a post on this...this morning...200 gallons per day per capita. That's 800 liters, more or less. South Africa, it's 50 liters.

So the simple concept is...let's do some for free, and then if you want to use more than that, you will pay a price. And that bumper sticker...this is actually a revolutionary idea as far as water is concerned. Almost no water on the planet is managed with this idea. It fits on a bumper sticker; it's a simple idea.

So if you guys got it on your briefing, it might be just as powerful or just as important in terms of solving a major problem. Not to say that it will implemented immediately, as I found out. So I want you guys to have a little bit more context on why this briefing matters in a bigger picture than 10 points.

*Is that your idea?*

This is my bumper sticker; I made the bumper sticker. But the idea...this combines two different concepts, and people don't talk about this in water. Turns out that...as I mention more than

once...water is one of the more backwards businesses in this world, and that's why it's so interesting to me because it's...so much low hanging fruit. So many easy things to understand.

It's not like trying to beat the stock market. Just as a clarification...extrinsic motivation...what does that mean? What does it mean?

*Something else is making you want to do something...*

Something else what?

*That's not you. That's pushing you to do something.*

For example?

*Like the government is making you do...like a regulation...*

Maybe. What's another example of extrinsic motivation?

*Any kind of carrot in front of you that makes you run. Some motivation from...your peers...*

Or grades.

You're extrinsically motivated by things that are outside of you: grades, money...fans who write you fan mail...

Intrinsic motivation...what is that? This side of the room?

*You're doing something because you want to do it. It makes you happy for...*

Whatever reason. It reminds you of warm cookies. The warm fuzzies.

So intrinsic motivation is you do it because it's inside of you. You don't actually care, necessarily, about outside rewards or anything like that. I explicitly am saying this again because some people on the briefing did not get this concept clear. And it's actually one of the basic things you should know coming out of this course. Not that it's emphasized often in economics. Economics is often been about extrinsic motivation. You just pay people, and they'll do it.

As I say to people who say, "All I care about is money." I say, "Go be a prostitute." And they go, "Oh, no, no."

So clearly there's an issue of what makes you happy. And some people are going to do certain things for certain reasons. But they have their own internal controls. So keep that straight when you're talking about things.

And both of them go into the utility function because the utility function is a big bag of everything.

Any questions? Any open questions on anything? No?

As I reminded you, next week there's no section, this week there is section. Next week we have class. Today there's a strike. Hope everything's going well for the striking people. And your homework is due, and that's about it.

So let's get into to discounting, which is some new material. It's all relative to this whole concept of climate change. So...a little bit of jargon on discounting...often, we use this letter "delta" for the discount rate. And then if you wanted to...let's talk about...so what does the discount rate mean? There's two different types. Financial and social.

Social discount rate is less than financial discount rate.

So what does a financial discount rate mean? Anybody have a definition of that? You would've gotten it in Accounting 101.

*Is it like...what you would pay today for a certain amount tomorrow?*

It's very much like that. So let's look at it in a simple "dollars and cents" thing. If you have a dollar today, and somebody says, "Can I borrow your dollar today?" And you say, "You want to hold on to it for how long?" "A year."

Okay...so let's say that you've got a dollar. And I want to borrow it. I'll give it back to you in a year. Can I give you a dollar back in a year, or do you want more or less than a dollar?

*More.*

More. How much more?

*Depends on the rates.*

Depends on the rates. Okay, you're just asking me my question back again, right?

Assuming, number one, that I'm not going to run away and not come back (which is a significant problem). The Bernie Madoff problem. But a dollar today might be worth a dollar times  $1+d$  in a year. And that delta can be anything from 0.2%, which is the money market rate right now in the United States, or 50%, which is the venture capital rate if you're going to be investing in a company. Maybe in 2 or 3 years, you want that kind of payback.

50% per year. How would you represent 50% per year for a dollar? I'm going to modify this. What would I do? Come on, math people.

*Is it 1 times 1.5?*

1 times 1.5, okay, and I want to do it for 3 years.

To the third right? So I'm going to put a  $t$  up there for time because it's compounded. Why would I take...say I've got...I'm a venture capitalist, and I have a million dollars in the bank. And the bank is paying me 0.2% per year. We're just going to assume this "per year" all the time now.

And then so-and-so the entrepreneur comes up and says, "I'd like to borrow a million dollars from you; I will give you shares of my company in exchange. And then I, the venture capitalist say, "Okay 50% interest rate."

Why is there such a margin between 2% and 50%? For me?

*Because the bank is FIDC insured?*

Right...besides this little issue of how much is insured. A million dollars or whatever. The bank is insured...what does that mean compared to the venture capitalists?

*You will get the 0.2% per year and take the money whenever you want it?*

Right. So there's a security of this, right? This is a short thing.

And what about the venture capitalist? Someone over here?

*It's risky because whatever they're investing might not be profitable, so it might be less than...*

What if it's like a  $\frac{1}{4}$  chance that I get my money back? Let's just say. That would be risk, right? Because I'm a venture capitalist. I know that over time, all these kids show up and they have all these great ideas, but only 1 in 4 really does succeed.

So what's my real return going to be on that investment with the kid, assuming I've got a bunch of them?

*12.5?*

Over time, it's going to be 12.5. Because I'm just going to do a risk adjusted interest rate. So it's 12.5% on average, which could be something along the lines... I actually said 0.2%, not even 2%, right?

But say that it's 0.2 against 12.5. In a sense, this is my risk adjusted interest rate. Am I risk averse, risk neutral, or risk seeking if I am willing to consider these investments evenly...even steven?

I heard seeking, neutral, and averse.

Who thinks seeking?

Who thinks neutral?

Who thinks risk adverse?

The risk adverse people are right.

A risk adjusted 12.5% return essentially says that I'm going to have 0.2% with 100% certainty. And I'm willing to trade that off (given that this is my opportunity cost right here). I'm willing to trade that off for a 50% return with a 25% certainty. That equals 12.5%. 12.5 is significantly larger than 0.2%.

My risk premium that I'm demanding is essentially 12.3%...additional. If it was risk adjusted... if I was risk neutral, what would this 12.5% be equal to?

0.2, right? It would be even...it would be like a coin flip, right? Risk neutral.

If I was risk seeking, this would be equal to what? Less than 0.2. I love investing in projects that might fail. So this venture capitalist is essentially earning a risk premium or demanding a risk premium. Those are actually the same idea.

Venture capitalists are not in the business for charity. They're in the business to make money. And, if you get competition among venture capitalists, what's going to happen?

*It goes down?*

That 12.3% is going to fall. The risk premium is going to fall because everybody's getting into business. It's well known...the easiest way to make a million dollars in a winery business is to start with \$1 billion.

Because so many people fail buying wineries. Or baseball teams for that matter. Those are vanity projects.

People say, "I just made a billion dollars in my dot com, therefore I am a genius because I got hired by Google, and now I'm going to go invest it in a winery because I'm a genius, and then you lose all your money."

So the thing is that as people enter the winery business, the returns on winery business gets driven down until you go down to risk neutral, or even, potentially, risk seeking.

And that means a whole bunch of investments get thrown into the winery business. That would not happen if there was not this huge demand to invest.

What happened during the last couple years in the real estate market is what? What's the big word that was in the news? Someone new here?

Has anybody heard of real estate? Anybody live in a house? Anybody who have parents who own a house? There's this thing called a mortgage. Upside down foreclosures. Anybody heard of those words? Okay. What happened?

*Subprime lending rates?*

Subprime lending rates? Okay. That's a key word. Put a verb and an adjective. What happened?

*There was a lot of subprime lending?*

There was a lot of subprime lending...is that what you're saying? Okay...so a lot of people who are essentially subprime borrowers were given loans by a lot of...what? Stupid banks? Greedy banks?

*Greedy.*

Greedy. Here! Take my money, take my money! I'm greedy to give you money!

It's one of those...I think it's kind of like...pointing the finger. Ooh, I didn't want that money to buy that big screen TV.

So what happened is...this wall of money went into real estate, and people who did not get loans got loans. People that had to put a down payment got a zero percent down payment. People that had...and people that were renters started becoming buyers, so prices went up, everybody felt wealthier because their equity went up, they got second mortgages, they invested that into a big screen TV, and the dual-lead trucks, and all that stuff. And then, low and behold, the demand for housing fell through a hole. It's almost like a Ponzy scheme. What would happen is that people would sell their houses to buy a more expensive house. And they could get a loan to buy a more expensive house, and they kept leveraging up. But as soon as the people stopped coming in on the bottom of the pyramid, buying new houses...you lost demand. You lose demand, the pricing momentum stops. And now, you're not making money on leveraging your equity. And cashing out your equity; you actually have to make your payment.

And the worse thing was that sometimes they had these so-called ARMs. Adjustable rate mortgages. And the teaser rate would come in at 1%, and it would readjust to 5%.

And when your mortgage payment goes from \$1500 to \$4000 a month, and you only make \$40,000 a year, or 50 or 60 thousand dollars a year...

If you make 60 thousand dollars a year, and your mortgage is 50 thousand dollars a year, you are not doing well.

So what happened is...the supply of housing was fixed, or it was expanding slower than demand. Prices jacked up, and then the market collapsed because people couldn't afford it anymore. It was based on a bunch of people coming into the business, trying to invest in real estate, driving down the risk premium,

And then a whole bunch of risky people were getting loans. And they were pushing up demand from all the people that were good at risks.

The economics of real estate in the last couple of years were surreal, and now they are also surreal in a sense that...I think it's 40% of people in California have houses that are worth less than the loans on them? That means they can literally walk away from their house and make money, except that they have emotional...intrinsic attachments.

*There's one thing I don't understand. So after this whole failure, the rates went up and lots of people got evicted, and the banks got left with all these houses for sale. What I don't understand is...why didn't the banks say, "Okay, since you can't afford the \$4000, but you've been able to afford the \$1000, and our choice is either to keep making \$1000 or to get this \$1000 every month, or to sit there with an empty house that we can't sell because nobody wants an empty house..." I mean...nobody wants a house right now...why didn't they just say, okay I'll just make a deal with you. And we will just bring more people...*

There's...what would that be in principle-agent terminology? What happened if you're the bank that just decided to readjust for people that couldn't pay their mortgages?

Are there other people in this world? I'm paying \$4000 a month, and you're the bank, and you're saying, "You can pay \$1000." Does anybody else in the room observe just what happened?

*No, but I mean...I'm saying that you can't pay the \$4000. I'm saying you're in the situation where the bank has...*

That's right. I can't. How about a thousand? Does anybody else have a mortgage? You're borrowers? The ones that can still afford to pay \$4000? What are they going to do? Woah, I'll pay a thousand.

So if you only have 10% of your loans are nonperforming (the jargon), 90% are performing.

If you give a break to that 10%, everybody else and the other 90% are going to be like...wait a second. They want adjustments down too.

*But what if it gets down to the point where 50%...when the number of people that cannot pay the \$4000 anymore, outweighs by far the people who can, then you end up with 10 people who can pay, stay in their houses instead of empty houses because you can't...*

It hasn't gone that far, but that's an interesting idea; it's never gone that far before.

*Don't you think that would affect the people that the banks sold the mortgages to?*

Oh, the resale of the mortgages?

*Yeah.*

Oh, so this is actually a much bigger problem right? A lot of mortgages were...I used to be a mortgage broker. So this is a bit of jargon. Mortgage brokers are usually fools and thieves, but anyway...not me.

So what happens is...if you're a home owner, and you get a loan...the broker, me...I'll go to the bank, I'll say...Countrywide Financial. I've got a loan here from someone who says they're worth a million bucks. And they're called liar loans, actually. Or ninja loans. No income, no job. So...I got a ninja loan for someone who says they're worth a million bucks. They can pay \$6000 a month. But that...the bank says, "looks good to me!" I'll buy that loan from you, the broker. I get paid my fee. I get 3 or 4 thousand dollars, I put that on my payment on my Mercedes, which I drive around. And then the bank...

Countrywide flips it over into the secondary market where it gets bought by insurance companies that are looking for long dated securities. They're looking for stuff that's 30 year maturity. Because insurance companies need to match maturity against their liabilities, which are their insurance policies. So then the mortgage broker, Countrywide, says, "Great, I just made a half a point; let's turn that money and put it back in the market. Go get some more ninjas." So the secondary...the insurance companies are like, "Holy cow, we have all these loans. What we should do...let's buy credit default swaps." Because that means if we have default on our loans, which have been cut, sliced, and diced by Morgan Stanley and Goldman Sachs, then, if there's a default, we're guaranteed against it, and we'll buy that insurance from AIG, which is the company that went bankrupt to the tune of \$150 billion dollars or more of tax money. So AIG says, "Sure, we'll buy it."

And if we get a reward, then we're going to make a fortune. If we lose, then the government will bail us out because we're too big to fail. Everything ended up shifting into our pockets (the tax payers, right?)

So that's how this huge ponzy scheme in the financial business happened. And in terms of... "Oh my god, what about foreclosures?"

There was no need to police your borrowers. You just sold that loan 3 times ago. Massive, massive moral hazard problems. And now the government has completely fucked it up... unbelievably. Like...forget the water business. They've unbelievably fucked it up by essentially guaranteeing all these banks that have screwed up.

The only one who's gone bankrupt so far, Lehman. After 150 years of business.

Did Bear go under or Lehman? Bear was sold on the cheap. They were rescued. Instead of \$80 a share, it was like \$2 a share. And it ended up going up to \$10. I think that was the deal.

Anyway. So that was a little...and I wanted to take that little side trip into discount rates and interest rates because there is a supply and demand for money. And that's how these rates go up and down. I want to take the last hand year, and then I want to get into social discount rates because we're never going to get through this. My ranting.

*I just wanted to make a point about what should the banks pay for mortgages...there are programs where the government subsidizes some part of the mortgage for loans...so that kind of gets at the same idea...if you actually can't pay,*

The government has actually been at the center of this problem in terms of causing this with the subsidies. I think you're trying to say something the government is doing that's good. But it turns out that it's like 10 times worse.

Because Fannie Mae and Freddie Mac, which were the big buyers of mortgages and guarantees of mortgages, started issuing guarantees like it was Christmas.

*I just mean...in the wake of everything...*

Well, in the wake, they're trying to guarantee people that conceivably can pay, but they're a little bit under water. Just need a little help, right?

*I don't know if that's necessarily true....*

What happened is that...we're going to renegotiate your loan. We're going to lower your payment. And about 1/2 the people that had their loans renegotiated have started missing their payments once again. They should, just basically, never have gotten loans. And they're essentially declaring bankruptcy, which is a huge problem because it's not...living on a cash basis that's such a huge problem, but it's nice to have credit. And creditry lending is the word that gets thrown around. There is this notion of borrowing, so I kind of lay blame on both sides. But the government completely messed this up in terms of guaranteeing a lot of banks that probably should've gone bankrupt long ago. Like...20 years ago. The same way that the airlines should've gone bankrupt, and GM and Chrysler should've gone bankrupt.

*Aren't Freddie Mac and Fannie Mae...they're not...they're not private...*

Oh, yes they are.

*Aren't they privatized?*

Nope. It was even worse than that. It was private, profit, and social risk. They were GCFs—government sponsored corporate entities. And they were guaranteed by the government, but they had shareholders who were making profits. That's pretty much a sweet deal. If you want to start paying off congressmen in terms of getting laws to help you out, that's the structure you want. If I make money, I keep it. If lose money, you take it. That's completely what happened. And they've lost over few hundred billion, dollars and now they're still...now they're flooding the market with more mortgage stuff. So we're not at the end of the real estate meltdown yet.

What's the thing here called a social discount rate? And why is it lower? What does it mean? Social discount rate? Make up a definition. Somebody new.

*How much you value the current quality of resources ?*

This is actually...

*What you said actually could be used and their quality of these resources in the future?*

Close... that could be...what you just said could be used for the decision of whether or not I should mine today. I've got gold in the ground; should I bring it up today, or should I leave it till tomorrow.

So...the question of how you are going to use your resources today or tomorrow will be influenced by the financial discount rate. That's what I told you before...that optimal extinction idea, right? Or wiping out a resource.

What is social discount rate? Think of the word root, social.

*Does the discount rate have something to do with externalities?*

Close, more?

The future of what? Not money, not resources? Society. It's one of those really tough definitions, okay? Social discount rate. The rate of...where you want to discount the future in terms of social goods—most notably the climate.

Do we care about having a clean climate today versus tomorrow? Or rather...do we care about burning fossil fuels today versus having a climate tomorrow. The social discount rate is what is being used in the calculation of how to deal with the cost benefit of climate change.

There was a report put out. The Stern report. Very, very famous in the climate change lit. I think it was about 2009, and Nicholas Stern, who is this smart guy, basically said...now, usually, the financial discount rate, if you want to just throw out...someone says, "Give me a discount rate." You just throw out a number. 3%, 5%, or whatever.

If you have a 3% discount rate (this here), and you're looking 50 years into the future...

Let me give you the inversion of this...the discount factor. The discount factor basically says: what is a dollar in the future worth? So...if I have a value in the future...I'm going to call it a value in year T times  $D^T$  is equal to value now.

So let's start with some obvious things. If your discount rate is zero,  $d$  of  $t$  is what? One. The value of the future is how much in current value?

One dollar in the future is worth how much today? A dollar today, a dollar tomorrow. Now, as we are discounting the future, like you would the way you guys learned about time preference... basically, if you put a 3% discount on something, and you take  $1.03$  to the  $50^{\text{th}}$ , and you put that under here, this  $d$  is going to be greater than 1 or less than 1?

*Less.*

Less than 1. So a future dollar is not worth so much today. A future benefit.

If you spend a dollar today, to get a dollar of benefits in 50 years, is that a good deal if you have a discount rate above zero? It's not a good deal, right?

If you spend a dollar today, and it's 50 dollars 50 years in the future (someone could do this with a calculator), we can figure out if it's worth it or not.

But you do need to discount it in what we call present value. Net present value is removing the cost of the investment today. Has everyone heard of net present value? If you don't, look it up.

*Is it the same thing as present discounted value?*

Yeah, all these letters get scrambled around. Present discounted value...net discount value... present discounted value does not include the net investment. You spend a dollar today. But the present discounted value is the value in the future put in today's terms.

Now, what we know is that as the discount rate goes up, the value of that future benefit falls. So if it's 50 dollars in 50 years, and my discount rate is 0.1, or 1% (let's just do 1%). If it's one percent for 50 dollars for 50 years, versus 5%...which one makes those 50 dollars worth more today?

1%, raise your hand?

5%?

Good, 1%. Zero...just think of the zero number. If it's zero, it's \$50. That's the biggest it'll ever get. We're not going negative.

So if you have a low discount rate, then the future is worth more today. That's essentially the logic. If you're investing money in a mine (or something like that) and you have a low discount rate, then you're willing to wait for those returns on your investment over a longer amount of time.

If you have a high discount rate, you're less patient. You want your money sooner. If you're a venture capitalist and you want 50% per year, you want your money now. Or a lot of money. Same thing right?

Now social discount rates, I have just asserted, are lower than financial discount rates. Why would they be lower?

*Tragedy of the commons?*

No. Why would they be lower?

Society. What is the most obvious connection between us in this room, and the future in 100 years.

*You die, but society will keep going?*

Who is society?

*Everyone?*

Think biology? Think the clinic down the road. Anybody intending to have any kids? Your parents did, I hope.

The future is us. In biological terms, in the survival of our genes, the future are our genes. We care more about the future than we do about financial returns because it's us. That's the logic behind that.

*I don't understand, then, why you even have the social discount rate at all. It should be...I mean...I think it should be zero soon because of the fact that...*

So the social discount rate should be zero.

*It should be zero because our children will still need a gallon of water and 2000 calories a day to survive. They won't need all the...unless we have the discount rate then they can survive less, so the apple today should be worth exactly the same as the apple tomorrow, because it will give them just enough energy. So there's no point...*

So the discount rate, social discount rate, is appropriate. What's an argument against social discount rate? And I don't mean relative to financial.

*We're here, they're not.*

We don't give a shit, right? That's a good one. It's very common. Whatever...kids...they're not my kids, or something like that, right? they're the wrong kind of kids.

*You could even say generations are limitless in the future, or the world's going to end in 2012.*

If the world is going to end in 2012, definitely party. And money will be worth nothing either, so go and buy those apples...and more likely, beer.

*Well, technology might be better, so they might not need...*

This is actually a very important comment. 100 years ago, we didn't have...I'm not going to say, "We didn't have iPods" because that's not necessarily the problem. But we didn't have the standard of living for exactly the same things. Our clothing was not as cheap or as high quality

because of technology. I'm not even talking about mining natural resources. Mining natural resources has been a huge disaster. But technology has made our lives better in many ways. In a sense of medical technology, drugs, or even the most basic stuff...vitamins.

Taking your vitamins or not dying of an infection because of penicillin. Basic stuff, right? So if you think in the future...should I sacrifice now so my poor kids in the future...but wait a second, they're going to have all these cool...they're going to have flying cars. Maybe I should sacrifice less, because they'll make up for it. So there's an argument against a low social discount rate.

The fact is the social discount rate should be lower than the financial discount rate. Where to set it is a different story. People that are techno-optimists (and there's a big group of them there). There was a famous bet, actually, between Julian Simon and Paul Erlich. Julian Simon was a techno-optimist. Ehrlich was alive, and Simon is dead. He was not that optimistic I guess. They made a bet. And Ehrlich was one of those...the world is going to end, population is out of control, and Simon was like, "Don't worry about it. We're humans. We always fix the problem."

And they always had this kind of rhetorical battle going on, and I don't know who started it, but basically...it's kind of like...put your money where your mouth is. And Ehrlich said, "We're running out of resources. We're going to be impoverished in the future." That's what Ehrlich said. And Simon said, "Don't worry about it. We'll take care of it."

And Simon said...I think Simon started it...he's like, "Okay, I'll bet you. I'll bet you that 5 of those resources that we're running out of...metals...are going to be cheaper in the future than they are today."

What would that reflect? Cheaper in the future than they are today. There's a fixed supply, we're talking metals. And we don't know what's going on with demand, usually demand is rising. Ehrlich's believe was that we're running out of things like oil. We're running out of coal, we're running out of gold, we're running out of palladium, or whatever the hell it is. So the price...what would Ehrlich say was going to be the price in the future—higher or lower than today? Higher. And Simon was like, "Nope, it'll be lower." And Simon said, "Choose. You choose any five metals you want. We'll buy 1000 dollars worth of them, and we'll get the quantity, and in ten years, we'll check in and see what they're worth. And if they're worth more than a thousand dollars, in constant dollars, then you win. Because they are scarcer." Does everybody understand this bet? And I will pay you the difference. So it's cash. It was a future's hedge. I don't think hedged it, actually. That would be even more funny. But anyway, he didn't hedge it. And if the price goes down, you pay me the difference. So who won?

*When was this done?*

80s. Around 1980.

Who thinks Simon won?

Who thinks Ehrlich won?

Simon won. It's not universally true that Simon would've won every time, and actually, I have a...I wrote a blog post on this over a year ago saying that Ehrlich bet on the wrong thing. It was

kind of a sucker bet. But Simon got...Ehrlich got to choose the metals he wanted, so actually, he kind of backed himself into his own corner. But the fact was is that the technology advanced faster than demand. Technology meant that we could get more bang for our buck out of those metals. And if you think about the most obvious one, copper...what's happened with the demand for copper in the last couple years? Over the last 20 years? I know you guys wake up every morning and look at copper futures. What's happening with copper? What is copper getting used for?

*It's gone down. Fiber optic cables are replacing them*

Right, copper wiring, goodbye. Fiber, which is made out of glass, which is made out of sand, which is pretty damn common. Except in Singapore. Apparently there's a good market for sand in Singapore.

So it turns out the demand for copper has collapsed relative to the trend. And technology was the thing that cut it off at the knees. So keep that in mind in terms of argument against low discount rate.

Regardless of that, Stern said, of his rape of the future, I think it was actually something like 0.2% which implies that we're going to spend money today.

We'll spend a couple billion dollars today, and we'll get a payback of \$20 billion dollars in 50 years in the future. That's a good deal at a low discount rate.

If the social discount rate was zero, that means a billion dollars today and 20 billion dollars in... a million years...is still a return on investment. Just keep the intuition and don't worry about the exact numbers.

So a low discount rate means that the future matters a lot. And essentially what Stern said in his report on climate change, written for the UK government, is it's worthwhile to pay a lot now to avert climate change, because the benefits to averting climate change are huge. Does that make sense? That is one of the biggest, biggest arguments in climate change. The whole Copenhagen thing...now I'll get into the US Congress in a second. I don't know...Mark Twain said a lot of good things about the US congress...they're all true still...thieves and liars and all that...so that's one of the big issues in climate change, and I'm bringing that up so you guys know.

Oh, another piece of jargon you guys should know is called hyperbolic discounting. That refers to a hyperbola. I don't even know what a hyperbola looks like. Does it look like this or something like that? Like that? That's a parabola? Hyperbola? What is that? You guys all know what a hyperbola is, right? Okay good. So here's hyperbolic discounting. Here's what it means...the definition. It means, essentially, that if I give you a choice, and I say, "How about... would you prefer a dollar tomorrow or 2 dollars in a week?" The vast majority...who says a dollar tomorrow? Who wants a dollar tomorrow? Who wants 2 dollars in a week? So it turns out that people are willing to wait for that \$2 thing. But they act as if they want that dollar tomorrow. They will not make...essentially, when you say you have a dollar today, what do you want to do...when you give them a choice...

Let me say this the right way...

People have a much higher discount rate on a tomorrow return than they have on a one-week return. So tomorrow is...if you have to wait for 24 hours, you've got to give me a lot of money. But if it's a week, you don't have to give me very much money, which is really weird, right? That means...and I mean relatively speaking right? If you took...let's start today with a dollar, and tomorrow it's two dollars.

And it's like 2.10 in a week or a year or something like that. People will go for...

People are willing to take this, even though this is a much better return. That's the kind of idea. I'm not trying to be confusing. The people...people are willing to be patient farther in the future compared to...like when you say, how about investing money for your retirement. People are like, "Yeah, whatever, I'll just throw that money away." But if it's like...oh I have to wait a year; I want a big discount...I want a lot of money if I have to wait a year. Does that make sense? A lot of money if I have to wait a year, but not very much money if I have to wait 40 years, which is really weird. But it's very, very common in terms of a pattern.

So it turns out that the one thing that's been adopted as kind of a way in using this to help people, essentially, is by taking money out of your paycheck now and sticking it in a retirement account, and saying you can have it if you want, but we're just sticking it in a retirement account, and people are like okay that's fine. They won't sign up for it voluntarily, but if they take it away, and you give them the option of ending the program (this is retirement program stuff) then they'll be like, "Fine, I don't care."

So they don't necessarily want it in their paycheck now; they don't mind it missing from their paycheck now if it's taken away for this future thing.

But if you take it away against tomorrow, they're like, "No, no, no I want my money now." I don't know if that sounded more convoluted...it sounded pretty convoluted coming out of my head. Does it make any sense to you guys? Does it make sense? You had a hand up, anyway.

*Does it have to do with the discount...like...increasing at a decreasing rate?*

It's not even that. This discount rate...let's say this discount rate is 20%; this implies a discount rate of 20%. This implies a discount rate of 5%. That's actually, probably, the easiest way to say it.

The sooner the return is to today, the higher the discount rate is that you're going to apply to it. So if we're doing this hyperbola, I'm going to make this...I'm going to call this a hyperbola.

In the short term, you want a high discount rate. In the long term, you're going to take something lower, which is unusual. Usually you want more and more money the longer and longer and longer. But you're willing to give up returns in the long run for some reason. There's a lot of experiment on this. It's like...it doesn't...like the whole term has become very fashionable in the last five years. No one even knew about it five years ago. But it's really important in terms of financial planning.

*But could it have to do with need? That people know what they need today and tomorrow, and next week. It's very present. They know...how much they're supposed to pay and everything, so money is worth a lot?*

It's not even need. It's called...I could give you this money that you never even had before. I can give it to you in a week (this much) or I could give you more, but not a lot more, far in the future. So in a sense, it's a gift no matter what. And people are...they want a lot more if it's in a week. Maybe because they can conceive of spending it. but as far as the future is...whatever, I'll take a smaller amount.

*But also consider they're willing to...people are willing to pay a lot of interest to get credit immediately, and pay for credit cards and things like that, but for the long run, for big loans, they're not...are paid off over a long time.*

That's slightly different in terms of pay day loans versus a low mortgage because of security and the profiles...stuff like that.

We're just trying to do apples and apples, though. So basically it's like this: if it's a short term return on your money, you want a huge amount of money. If it's a long term return on your money, they'll take less, which is completely the opposite of people usually expect. But it's very much operational in what's called behavioral finance, which is very, very sexy.

One of the guys that's behind this, Richard Baylor, [inaudible] is famous for this. I think they wrote this book: *Nudge*.

And one of them is the...I think...the Director of Regulations in Obama's administration. That's kind of a heavy duty deal in terms of changing the way a government operates.

I'm bringing this in just to mention because we're talking about discounting. Alright, now, remember, there's this huge issue that comes back in climate change, that came out with the Stern report, about the difference between risk and uncertainty. Which one can we quantify? Risk, can we quantify risk or uncertainty?

Who says uncertainty? Quantify? Who knows what quantification means?

*Put a number on it*

Put a number on it? Give me better than that. What does a PDF mean? Besides an Adobe Portable Document Format.

Probability Distribution Function?

Yes. Awesome. A probability distribution function.

It essentially is...guess what? Your old familiar friend the bell curve. We've got...the highest chance that we're going to have this return, X percent,

Let's call it gambling in Vegas. It's likely that you will make 0 dollars. That's not the right idea...the point spread on the game, okay? It's likely...after you adjust the point spread on an athletic game, the point spread is going to be zero most of the time. That's going to be some X percent.

A big blowout either way is less likely. It's a probability (the probability) distributed in a function. A PDF.

Now...if you have a PDF, flipping a coin, the average grade in this class, the scores of teams or players or whatever, if you have a PDF, then are you talking about risk or uncertainty? Risk, because it's quantified. That's what I mean by quantified.

Uncertainty is...a lightning bolt strikes you. Or...you win the lottery, in a sense. I guess that's probably not true because the lottery has a statistical distribution, except that you're down here in the likelihood that you'll win. Falling in love is an uncertainty. Some people try to make it a number's game, but it doesn't usually happen that way.

So uncertainty is something you cannot quantify. And when you worry about things like climate change, and if the ocean is going to turn into a gooey soup, or is an asteroid going to destroy the earth in 2012, those are uncertainty, although it's not, because NASA says so. Those are uncertainty things. We cannot quantify it. And if you cannot quantify it, you cannot put a bet against it, and you can't put a discount rate against it. So basically, what Nicholas Stern said about climate change is there's some really big bad things out there that if they do happen, they're going to wipe out the human race. So we should invest now just to be sure because of risk aversion.

*In terms of uncertainty versus risk, the government panel on climate change says there's a 90% chance that catastrophic climate change will occur. So is that purely risk, is that a 90% chance...*

They've quantified it in terms of risk, that's right. Because uncertainty is: this might happen, it might not. We're not quite sure what's going to happen. The reason that they come up with these 90% numbers is that they run models over and over again trying different inputs in terms of parameters and the way the model interacts. And they look at all the different results, and they get a whole PDF of results in the future. Kind of imaginary, right? The [inaudible] on climate change are like, "It's imaginary." Well, yeah, so is the NFL, right?

So what they do is they get a distribution of outcomes, and they say 90% of our outcomes fall in this range, which means that we're 90% sure that it's going to happen...statistical jargon is difficult to present correctly, but let's just say it this way: they're pretty sure that's going to happen. Or climate change is going to happen.

*Is that like a confidence interval?*

Yeah, it's a confidence interval. It's the same idea, okay? the whole idea of a confidence interval is that 90% of the time when you do this thing, it's going to fall on that interval. It doesn't mean it's going to fall out of the interval, or it doesn't mean that 10% of it is outside of the interval. It means that 90% of the time, your random draw is going to be in that interval. So in terms of climate change, we're basically saying, 90% of our scenario has fallen...this uh-oh scenario. So we should do something about it.

10% of the time, it's way worse. And 5% of the time it's way worse. It's on one tail and the other 5% it's on the other tail. That's essentially what happened behind the Wall Street melt down is that when they did this PDF...this is a useful jargon to know. If anybody wants to read about the financial market, read *The Black Swan*. This is the most amazing book. So basically, they have a PDF. You've got these tails, and this is a 1% chance, and this is a 5% chance. So

you have a probability of ending up in one tail, right? We have fat tails; that means that the reality...let's do it this way....

This is what they predicted, and they're saying, "This is never going to happen. That's a 0.0001 percent chance. And this is a 0.1%. See that little tiny area under there? That's what they mean by...that's a small probability. If you have fat tails, it turns out that the likelihood of ending up in that end is much bigger than you thought, right? And what they said in Wall Street...oh it's a one in a thousand chance...one time in a thousand years, except that it happens every four years. You know that the statistical model is broke. And that's what happened. Their statistical models were based on a bunch of crap. Self-serving crap by the way, because they were all paying themselves bonuses.

So these are some background ideas in terms of what I want to call cost benefit analysis. Or benefit cost analysis...I tend to call it cost benefit analysis, but I don't care how you guys do it. So...I'll just do it this way.

Benefit over cost.

If you have this ratio, and it's discounted into present value, present dollars, and you're looking at that investment, is that a good idea to do that investment? To invest in that climate mitigation thing...to worry about...to invest in the housing market, to put money into your own education...is that a good bet? Yes? Okay, greater than one.

Now, what if your BC of project A is equal to 1.2 and project B is equal to 1.5, and you've done good analysis on both of them, which one should you do? The lower one, right? You should do a higher benefit for your given cost. Did people see the airline post that I sent out? The baby seats on airlines?

I had to read it because I was pulling a number out, and I was telling you guys it was 2 million dollar per life saved. 1.3 billion dollars per life saved. That's the benefit, no sorry, that's the cost...the life is the benefit. The cost is 1.3 billion dollars. Now, it's positive. Oh no, is it positive? So we know the cost is 1.3 billion. What's the benefit? A life. What's the jargon for how much a life is worth in economics? Value of a statistical life. VSL, according to EPA, and this is the kind of numbers they use when they're evaluating...should we allow people to spray dioxin over each other or something like that. A VSL...let's just round it up to 7 million dollars. Life is not priceless.

I already told you about the airline tickets—how Americans are worth more. This is an American. You've got 7 million benefit over 1300 million.

How's that VCA looking? Good investment? No.

So, luckily the FAA actually realized this. Reagan, one of the good things that Reagan did, is he actually said we should benefit cost analysis for regulations. It had not been done before.

The Environmental Protection Act, Endangered Species Act has no provision for cost benefit. If you've been following the debates about water in the delta, you know that people are saying, "It's a 3 inch fish. Children are dying. Lives are being forsaken."

But there is no cost benefit for Endangered Species Act. If the species is going to go extinct, it does not matter what costs you incur to humans and to society, you will act to defend that species. This can get very expensive. In my opinion, it's not true for the delta, but it can get expensive in other places. Oh, let's do game theory for a second. Who's heard of the Northern Spotted Owl?

Good. And they live in forests.

The forests are often used for what? Lumber right? They are logged. Now, you're walking along in your forest, and you're a Corporate Forester, and you see a spotted owl nest. And the regulation says, "Thou shalt leave the owl alone plus the surrounding 500 meters. And you say, oh good, I'm going to cordon off these 500 meters of trees that are worth 2 million dollars so we protect that owl, right? No. You kill the owl.

Shoot, shovel, and shut up is what happened. And the interesting thing was...the people who had these owl habitats were not going to get any money for protecting the owl. So some clever environmentalists...the free market guys, have said...how about we pay you to keep the owl there? You can grow your trees longer...maybe the owl migrated, maybe they'll die of something not human.

This actually started...the most famous example of this was the reintroduction of wolves to Yosemite national...no...to Yellowstone national park. All the farmers were like, "Oh my god the wolves! They'll kill my sheep." And they would just shoot wolves on site regardless of whether or not the wolves were killing sheep. So that...the wolves (I think they were gray; I'm not sure) were going extinct. And these guys said, "Hey, wait a second. If they kill your sheep, and your sheep is worth \$50, and the environmental value of the wolves are \$5000, which is kind of like...they figured it out, right? If you lose a sheep, we'll pay you \$50. And they went further than that. So the farmer—does he have the incentive to kill? Not really. Right? It's like...I've got a dead sheep. You have to certify that it's wolf-dead and all that stuff. But they went further than that.

If you have wolves that are having cubs on your property, we'll pay you a bounty of \$1000. So now farmers are like, "Come here little wolf! Come here!"

They want to have little wolf cubs on their property. Stuff like that. Now the same thing happened. This incentive is quite good in terms of trying to get people to make nature work for them.

If you did the spotted owl, it's like...I've got a spotted owl nest; give me \$1000. And some enviro would write a check. That would be the theory, right? Except some enviros try to get things for free.

Same thing with the national parks, especially in developing countries. It's a park; keep all the... did I already do the park rampage with you guys? Keep all the locals out? Kick them out because we have to have the gringos show up and pay \$20 or whatever?

So they lose their house, they lose their hunting grounds, they don't get any money, and the landowners are zooming back and forth.

So they become poachers for shooting the wildlife that nobody owns. And before Zimbabwe descended into utter darkness under Mugabe, they had one of the more popular and successful wildlife programs where the local people would manage their wildlife, and they would sell the heads of a big megafauna. If you were a hunter, and you wanted to kill an elephant, 15 grand. Shoot them. And so the locals would love it. Come and shoot our elephants. \$15,000—that's a good income. And would they defend elephants against poachers? Hell yeah. Those elephants are valuable, right? So that program was working to benefit the local community.

In turns out in Southern Africa you've got a much bigger problem in terms of too many elephants, not too few. But in places where they ban people hunting elephants and poaching and stuff like that...or ivory sales, for example, you've got a black market. And who are the people that most likely shoot the elephants?

*The locals?*

Not just the locals. Worse than that. Around these parks? The rangers. The rangers shoot the elephants and then take the ivory and sell it to the black market. It ends up in Hong Kong and stuff like that.

So think of the incentives. Think through the incentives. Benefit cost analysis. Okay good, we're doing well.

Now the problem with benefit cost analysis is there's this thing called...we're going to have a program about the future, and it's going to rescue baby dolphins. And I'm a baby dolphin fan, and in fact I like eating baby dolphins. They're really yummy. Baby dolphin sushi. I think they're only...in the environment they're probably worth like \$50.

Does anybody have an opinion that's different to that? What's a baby dolphin worth to you?

*A thousand dollars.*

A thousand dollars. Oh yeah? \$50 dollars.

*No.*

No, right? That's how the negotiation happens. NO.

So there's a problem of quantifying the values of these things. And this gets into the classical problem of what's called willingness to pay versus willingness to accept.

And if I said to you, "I want to kill a dolphin and eat the sushi, how much do I have to pay you to do it?" You would say, "1000." And then I'd say...you know what, "I have a baby dolphin right here, and I'm going to kill it." Unless you pay me...how much money? How much are you going to pay me? How much are you willing to pay to save the dolphin?

*\$1000?*

That would be unique.

*\$10,000.*

\$10,000—sold. How much is...but thing is that there's...I'll present this to you because you just said you'd be willing to pay more than you'd be willing to accept, which is an unusual inversion.

How much is a blue whale worth? A million dollars...but here's what usually happens. Willingness to pay is less than willing to accept. And we're not talking about...I don't have an income constraint.

It's basically when people say, "Oh, you're asking me how much money I want to kill that little charismatic beast? I want a lot." How much am I willing to pay? Well, not that much because I've got to get a big screen TV, my kid's got to go to a private school...

So there's this huge problem of willingness to pay being less than willingness to accept. That shows up all the time in environmental issues. How much is that old growth forest worth to you? "Oh, so much."

The Arctic Wildlife Refuge---what's the acronym for that? ANWR, right? ANWR...who can even find it on a map? Good, congratulations.

But how much are you willing to pay? Well, I don't know. \$1 a year? \$50 a year? Start writing checks. Now this gets to the collective action problem called: the oil companies can coordinate against you. But prior to that problem is that there's a little issue here of what's called cheap talk, which is...how much are you willing to accept? "Oh, a million dollars."

Because you can just say a million dollars. Right? You might be willing to let flipper go, And if I put \$100,000 on the table, you might be willing to let Flipper go. Real money it's \$100,000. Or, even worse, if you say, "Oh, it's worth a million dollars to you? you pay me a million dollars." You go, "Oh, no, whoa wait a second." But I'm right because I'm good because I love the environment.

Being good and being right is not worth money. Money is worth money. This is a continuing, ongoing debate in environmental...this is environmental economics. This is not resource economics. Environmental economics—what does that mean in terms of a market? There is no market. You basically have people making up shit. Because there is no market. It's worth so much to me.

So when you get into benefit-cost analysis, and you start putting in these kinds of numbers, then things start going crazy because you know that Redwood tree, when it's milled down to paneling for your hot tub, is worth this much. What is it worth as a growing tree? There's a huge gap between willingness to pay and willingness to accept. If you put those numbers into benefit cost, then things start to move very fast up and down. Some of the most...the biggest research on this was around...I'll get to Hetch Hetchy in a second...was around the oil spill in the Exxon in Alaska. Every oil bird that showed up on TV...people were willing to pay a lot. Or, even better, to accept a lot in terms of beating up Exxon in court. That's why Exxon had to pay billions of dollars because the court judgment was based on willingness to accept. I actually...one of my favorite examples of this is Hetch Hetchy reservoir...it's called the O'Shaughnessy Dam Reservoir up in Yosemite...you guys know about that? John Muir broke his heart because it got dammed up by those evil people from San Francisco. Around 1910, or something like that, they built this reservoir, they built a canal (an aquaduct) to bring this water down to give drinking water to San Francisco and the Peninsula, and there's been a movement to restore Hetch Hetchy.

A movement to restore Hetch Hetchy...who's hear of the Restore Hetch Hetchy movement?  
Estimated price tag: 5 billion dollars. Who remembers what this acronym means? OPM?

*Other people's money*

Other people's money. Who's going to pay the 5 billion dollars? We the tax-payers. Did I do this rampage already? No? I'll give you the short version.

So...people at environmental defense fund and other organizations said we have to restore Hetch Hetchy because it's a good thing. It's going to cost \$5 billion. My question is: are you guys willing to pay \$5 billion? In fact, I said a much simpler number:

*I don't know...I think that the other side, people are willing to pay \$1 billion a week for like... war...i don't know...*

Right. That's called switching...that's called changing the argument to something else that you prefer to talk about.

*Not necessarily; I think it's kind of showing people's priorities...like what they are willing to pay for.*

Right, but we're not looking at the opportunity cost of Hetch Hetchy versus the Iraq war. We're looking at: should we spend \$5 billion to restore Hetch Hetchy or not?

It's very important. It's a good point because people do change the topic immediately. I got into this debate with someone about NASA. It's like...but NASA's only 1% of the federal budget! I'm like, "It doesn't mean you can just waste money, still."

A billion here, a billion there, after a while it adds up. That's the expression. So if you treat Hetch Hetchy alone as a question, then you have to ask: \$5 billion. Okay, Environmental Defense, I said to this guy...just pisses him off...

*Wouldn't it make more sense instead of saying \$5 billion...to say cost per person or per taxpayer?*

That's exactly right. But I made it simpler than that. I said, "If you can find 1000 people to donate 5000 dollars each to pay for this, your donors...you've got a mailing list...5000 people, \$5000 each...how much money is that? Oh sorry, 1000 people, \$5000 each...how much is that?

*5 billion?*

No, it's 5 million. 5 million is still 1/10 of 1% of the total cost of that project. So basically I said, as a threshold, called "I will talk to you about this question" (not that I have any power)... but I'm not even going to talk to you guys unless you've got 1/10 of 1% of money on the table to pay for it. And I bet they couldn't even get that. Because they would rather have it come out of the general fund. And they'll have a lot of bumper stickers that say, "Save Hetch Hetchy"... those cost \$2.95. But ask for \$5000 from that person with the bumper sticker, and then you'll find out where they really...whether they're willing to put their money where their mouth is.

*But isn't it not fair? It's not like only those 1000 people have to give...if everyone will benefit, people just don't...people have different...*

Perfect. That's a perfect segue. Everyone will benefit and everyone will pay. Every person in the state of California...if you assume 50 million people...that's still \$100 per person in California.

I prefer Hetch Hetchy the way it is. Will you give me \$100 to restore it? Will you give me \$100? He didn't do it; now I need 200. 300. Can you give me \$300?

See how that become a problem? That's just on the cost side.

The benefit is usually...oh, what about everybody? And this is an awesome argument that was brought forth by (guess what) someone from San Francisco. They said, "Hey if we had 5 billion dollars..." What's that word? Opportunity costs. We could spend \$5 billion on urban parks to help poor people, because who would go to Hetch Hetchy? A bunch of enviros in Volvos, who are like 300 people in the whole state. We'

So let's leave it at that. We'll get on to more of this stuff on Tuesday. See you with your homeworks. Have a good weekend.

**Transcribed and checked for accuracy by Brynna Bunnag**