[SQUEAKING]

[RUSTLING]

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PROFESSOR: Today we're going to turn to a new topic. Remember, we're in the topics part of the course now. We talked about factor markets and things like investing decisions and interest rates and things like that. Now we're going to come to a new part of the course, which is to talk about international trade. International trade is one of the central issues in all of economics.

As with every topic we cover in this course, we won't do it enough justice. We'll just do two lectures. But if you find it interesting, we have an entire course called 1454, which is all about international trade. So just give you a taste of how we can apply the tools of basic microeconomics to important questions, one of which is trade.

Now, here's a question for you all. How many of you have ever given or received roses on Valentine's day? The unromantic MIT crowd-- it never fails to amaze me. OK, well, turns out, Valentine's Day is uniquely badly positioned for the US because it's in February, and that's a hard time to grow roses. So for years, what we did, if you wanted to give roses in February, you had to buy them from hothouses that were specially set up to grow roses so you had them available in the winter.

To deal with this inefficiency of a flower-based holiday being in February, we had to have special production of roses. Well, that changed because it turns out that the perfect place in the world to grow roses is right around Colombia and Ecuador in South America. They're perfectly tempered. They're on the equator. You can always grow roses there very cost-effectively.

Indeed, when I visited Colombia and was driving around, there are these enormous rose farms. I got to stop at one. They have 15-- literally, this rose farm we stopped at shipped out thousands of roses every single day to all over the world. They even had different sections for different countries.

So in Russia, they like long-stemmed roses. They had a Russian section with long-stemmed roses. They had a US section with the kind of roses we like. It was an incredible production. And it's easy because it's warm there all year.

So the question is, is that a good thing or not? On the one hand, we get cheap roses, and if you all were a little more romantic, you might value that. You might value having cheaper roses that you could buy. Or maybe you would be more romantic. Maybe you're just romantic but fiscally prudent. With cheaper roses, maybe you can give more roses to your loved ones.

On the other hand, all the guys who had jobs producing roses have lost their jobs. There were presumably hundreds if not thousands of people involved in growing these roses in the US. They're now out of work because we get them from Colombia. This debate over the fact that consumers get goods cheaper, but producers lose their jobs is the heart of the debate over international trade.

This is a particularly important topic right now because, traditionally, the divide over international trade, as I mentioned when I talked about voluntary export restraints, was strictly broke down along party lines, with Republicans favoring free trade and Democrats opposing free trade. That's reversed over the last several decades. The largest free trade initiative of the last 50 years was Bill Clinton's NAFTA, a Democrat's bill, the North American Free Trade Agreement, which opened up trade between the US, Mexico, and Canada in a very free basis.

And the biggest opponent of free trade in the Oval Office in the last 50 years was Donald Trump, who used tools of trade to go after China, declare economic war of China, in particular. Donald Trump imposed a tariff, which is a tax on imported goods from China. So, in fact, parties have reversed.

Now, it turns out basically now we're in a situation where everybody's against free trade. Indeed, President Biden has kept in a lot of the Trump anti-trade practices that were in place. Free trade is very unpopular right now.

Now, the extent to which countries participate in international trade is described by two quantities. There's exports. Those are goods produced domestically but consumed abroad. And there's imports, which are goods produced abroad and consumed domestically.

So exports are goods that a country sells to the rest of the world. Imports are goods a country buys from the rest of the world. Currently in the US, we have about $2 trillion worth of exports. We currently export about $2 trillion worth of goods, and we import about $3.2 trillion.

So exports are $2 trillion. Imports are $3.2 trillion. The difference, imports minus exports, we call the trade deficit. So we have a $1.2 trillion trade deficit. That means we import about $1.2 trillion more worth of goods than we export.

This was a large focus of the Trump presidency and of many politicians. It was viewed as a sign of US weakness that we have this giant trade deficit with other countries, that we're exporting quite more than they we're importing. But in fact, that intuition is completely wrong.

And to see why, let's start with a simple example. Suppose you and your best friend both love Pokémon. And you love all the Pokémon equally. You want to collect them all. You got to catch them all. You love all the Pokémon equally. You love Pokémon, your friend loves Pokémon, and you value them all pretty equally.

So let's say that you have two Pikachus, and your friend has two Jigglypuffs. And let's say you and your friend think Pikachus and Jigglypuffs are pretty much worth the same thing. I'm not a Pokémon aficionado enough to know if that's true. But let's say they're roughly worth the same thing.

So let's say you go to your friend and say, look, I have two Pikachus. You have two Jigglypuffs. I'm going to trade you one Pikachu for one Jigglypuff. And your friend says, yeah, that's great. I'd love that deal. I don't have any Pikachus.

So you make the trade, and you go from two Pikachus and no Jigglypuffs to one Pikachu and one Jigglypuff. And your friend goes from two Jigglypuffs and no Pikachus to one Jigglypuff and one Pikachu. Now, what you've just done is created a Pikachu trade deficit.

Think about it. You used to have two Pikachus. I'm sorry. You've just created-- I'm sorry-- a Jigglypuff trade deficit. You've just imported one Jigglypuff, and you've exported zero Jigglypuffs, so you've created a Jigglypuff trade deficit.

You could see presidents ranting about the Jigglypuff trade deficit. America will always be a second-class nation as long as we have a Jigglypuff trade deficit. You might say, well, that's silly, and you'd be right. That is silly. But it's no sillier than worrying about the general trade deficit.

Indeed, let's just imagine we replaced you with the United States, your friend with Colombia, Pikachus with dollars, and Jigglypuffs with roses. Then we just made the same trade. We just sent them dollars to buy roses. It made us better off because we wanted the roses. It made Colombia better off because they want our dollars.

So who lost? No one lost. It was just a trade that made both sides better off, which is what trading does. We've created a deficit with Colombia, but only because the deficit is measured in dollars, not in welfare. Yes, we have a trade deficit, but we also now have a surplus.

And just like we don't care about Jigglypuff deficits versus Pikachu surpluses, we don't really care about dollar deficits versus goods surpluses. We're happy to make this trade. And indeed, blocking this trade would lower social welfare for the same reasons that blocking any trade where the marginal benefits exceed the marginal cost lowers social welfare.

That's the fundamental intuition, one of the first fundamental law of welfare economics, which is that basically any time there's a trade where the marginal benefits exceed the marginal costs, you should allow that trade to be made. And if you don't, welfare is lower.

And that, in a nutshell, is why economists support free trade. That's it. And we'll go through the math and stuff like that through this lecture. But that's really the intuition is that economists support free trade because if there's a trade that both parties want to make, we should let it happen.

Now, of course, this is much more complicated in reality. One complication arises because of the issue we've just been discussing in the last few lectures, which is market failures. Trades only make both parties better off if you're in a perfectly competitive market. If not, they might not make both parties better off.

Another issue is that we might care differently about winners and losers. Remember, I've discussed in this class how the classic definition of social welfare simply adds up producer-consumer surplus. We said that has some nasty implications. For example, we're totally indifferent between a perfectly competitive outcome and a perfectly price-discriminating monopolist outcome. We're perfectly indifferent between consumers getting some surplus and consumers getting no surplus. That doesn't feel right.

Likewise, we might not be indifferent between people getting cheaper roses and other people losing their jobs. And as a result, the standard model might not work in reality. But it's important to understand the standard model first. It's important to understand why economists favor free trade. And then we can talk about, in the real world, why there might be rationales for opposing it.

So that's the setup for what we want to talk about, international trade. I'm then going to-- to understand international trade, I'm going to introduce a new tool into our toolkit, which is the Production Possibilities Frontier, the PPF, the Production Possibilities Frontier. The production possibilities frontier is going to introduce a new concept.

We've talked about economies of scale. Economies of scale is the idea, if you get twice as big, you produce twice as much. Now we're talking about a new concept, economies of scope. Economies of scope are relevant when you, the firm, produces multiple different goods. An economy of scope arises when producing one good makes you more productive at producing the other good.

A diseconomy of scope arises when producing one good makes you worse at producing the other good. And we illustrate this, economies of scope or diseconomies of scope, through a production possibility frontier. As an example, let's go to figure 18-1, figure 18-1a. OK, here we have an economy of scope. So let's think of a simple example. As always, it's easier with two goods.

Let's think of yourself as the firm. You're the firm, and you produce two things. You produce exams and problem sets. That's what you do. That's life at MIT, right? You're a firm at MIT. You produce exams and problem sets. That's your life for four years.

Now, imagine that you have a certain amount of inputs. Now, obviously, you can vary your inputs, and that could lead to economies of scale. Twice as much time studying could double your score, or it could less than double your score. That's economies of scale.

But now I'm saying, let's hold the time constant. Let's say a certain amount of time you want to spend studying. Now the question isn't how much time you spend studying, which is the economies of scale question, but how you devote your time, which is the economy of scope. And let's say, for example, that the course has 10 problem sets worth 20 points each or one exam worth 200 points. That's the way the grading of this course works. And your goal is to get the best-possible grade.

Well, you can decide how to devote your time between working on problem sets and studying for the exam. Imagine it's multiple exams with 200, to make it a little more continuous. There's multiple exams worth 200 points total. So you can decide how to devote your time throughout the semester by working on problem sets or studying for the exam.

So let's say, for example, you decide you're going to spend all your time studying for the exam and none working on problem sets. Then you're at the x-intercept in the linear PPF. You get a perfect score on the exam, but 0 on problem sets. Likewise, if you decide to spend all your time on problem sets, you might get a perfect score on problem sets, but you'll get 0 on the exam.

We've drawn the first graph as if it's linear. Literally, it's an equal trade-off. Every point you give up on an exam, you get in a problem set. But in fact, there's strong reasons to believe that there would be economies of scope between doing problem sets and how you do the exam or between studying for an exam and doing the problem sets because it's the same work.

The more time you spend on problem sets, the better you might do in exams. The more time you spend studying for exams, the better you might do on problem sets. That would lead to an economy of scope and an outward-bending PPF. That leads you to scope. And basically, you'd have a convex production possibilities frontier.

The convex production possibilities frontier arises when it's more efficient to produce goods jointly than it is to produce them separately. So if it's ever more efficient to produce goods jointly than separately, then that will give you the convex production possibility frontier. We call that an economy of scope. It's more efficient to do stuff together than do them separately. Questions about that?

Now, you can also get diseconomies of scope. That would be illustrated in figure 10-1b. That would be a concave production possibility frontier, where literally you're better off doing one or the other, but the combination of the two makes you worse.

Now, it's hard to see that in our example. Let me give you a real-world example of this, which is when I was an MIT undergraduate, I was a pretty good tennis player. I was on the MIT tennis team, JV. I wasn't great, but I was on the tennis team. but I'd never tried squash before. And people said, you're at college. You're an elitist East Coaster. You've got to play squash.

So I decided, fine, I'll go try squash. Well, it turns out, tennis is all about not using your wrist, and squash is about using your wrist. Tennis, you're about trading that ball. Flat squash, you're about slicing it and hitting it using your wrist. And it turned out, the more I played squash, the more it screwed up my tennis game. And the more I played tennis, the more it screwed up my squash game.

That was a diseconomy of scope. If I can use such an elitist example of a diseconomy of scope, where doing one made me worse at the other one. So both things can be true. You can have both economies of scope and diseconomies of scope in your production possibility frontier. Questions about that?

OK, with that in mind, now we want to turn to our classic model of trade. We're going to talk about-- this is really one topic. Sorry. I wrote this with a thin chalk. It's hard to see-- comparative advantage and models of trade. So we're going to turn to the topic of comparative advantage and trade.

Now, the way we think about international trade in a convenient way is we use what's called two-by-two models. This is the workhorse of international trade. If you take 1454, this is where you'll start, 1454. two-by-two trade models-- two countries with two goods. There's no money in these models. It's two countries, two goods.

So let's, for example, imagine our two countries are the US and Colombia, and our two goods are roses and computers. So imagine a world with just two goods in them, roses and computers, and just two countries that produce those goods, the US and Colombia. The idea is, Colombia, it is relatively easy to grow roses because the weather conditions are such. But in the US, it's relatively easy to make computers because we have highly skilled workers.

So that's the setup of the model. So we're going to put particular examples on it. Here's a particular example. This is the way a two-by-two model looks. So for example, let's say we have two goods. We have roses and computers. Let's say we're talking about a dozen roses versus a computer. So this is a dozen roses versus a computer.

And then we have Columbia and the US. And let's say that the only input to producing these goods is labor. Obviously, untrue. Certainly with computers, there's a lot of capital involved. But once again, we're going to start with this easy model-- two goods, two countries, one input.

Obviously, all those numbers can expand. You can have two goods, two countries, six inputs or six countries, eight goods, four inputs. Anything can go on. But life can be easiest if you have two countries, two goods, one input. The input is labor.

And that input produces-- we're going to have a constant returns to scale model, where basically we're going to simply say that to produce one carton of roses in Colombia takes one worker. It takes one worker. I'm sorry. It takes one hour of labor. These are hours of labor.

So to produce one carton of rose in Colombia, it takes one hour of labor. To produce one computer, it takes eight hours of labor. In the US, to produce one carton of roses takes two hours of labor, and to produce one computer takes three hours of labor.

Now, based on these numbers, we can draw the PPFs for the US and for Colombia. And they're going to be linear. I haven't put any economies of scope in here. I've just made them linear.

So if you look at figure 18-2, here are the PPFs for Colombia and the US. In a given day, if we think of a budget of 24 hours-- so imagine we're going to do the PPFs for a given-- remember, PPFs are about for a given set of inputs. Here's, this input is going to be 24 hours of labor. Before, it was a certain amount of time you had studying. Now it's 24 hours of labor.

For a given set of inputs, which is 24 hours of labor, what can we produce? Well, in Colombia, with 24 hours of labor, we could produce 24 cartons of roses or three computers or some combination of the two. In the US, we could have 12 cartons of roses or eight computers or some combination in between.

The line connecting those is the PPF. The PPF shows you the combinations you can have for a given level of inputs. And in our example, it's linear, just to make life easy. You could obviously make it more complicated with economies of scope or diseconomies of scope, but it's easiest if it's linear.

So you've got these simple linear production processes-- one input, constant marginal cost. It's just literally constant marginal product-- I'm sorry-- constant marginal product of labor. Literally, every time you want to produce another rose, it takes one unit of labor in Colombia, two in the US.

So lots of assumptions floating around here. Constant marginal product of labor-- one input, two countries, two goods. OK, questions about that? Let me pause. This is a hard but important model. Let me see if there's questions about how this is set up. OK.

Now, we want to ask, who has the advantage in producing these goods? And the way we want to ask it is through the lens of comparative advantage. That is, we don't want to ask, who's better at it? We want to ask, who's relatively better at it?

So for example, who has the comparative advantage in roses? Well, Colombia-- to answer this question, we go back to opportunity cost. And the reason we think of things in relative terms is because then we can express the opportunity cost mathematically. What is the opportunity cost of producing a box of roses in Colombia? What do you have to give up to get a box of roses in Colombia? What do you give up? Yeah?

AUDIENCE: One hour.

PROFESSOR: What?

AUDIENCE: One hour.

PROFESSOR: One hour. But what does that give up? But it's all-- the hour-- yeah?

AUDIENCE: 1/8 of a computer.

PROFESSOR: In Colombia, you give up 1/8 of a computer. That's exactly right. So it's time. OK, I love the celebration that we've got the answers right. That's good. You celebrate that. You're doing a great job.

OK, so in Colombia, the opportunity cost of a box of roses, which takes an hour, is 1/8 of a computer, which also takes an hour. In the US-- [INAUDIBLE] an hour-- what's the opportunity cost of a box of roses? 2/3 of a computer.

So the opportunity cost of a box of roses in Colombia is 1/8 eighth of a computer. The opportunity cost box of roses in the US is 2/3 of a computer. So what we say is, since Colombia has a lower opportunity cost, they have a comparative advantage in roses.

Colombia has a comparative advantage in rose production. Why? Because the opportunity cost is relatively lower. Flipping that-- OK, so let me stop there. So Colombia has a comparative advantage in roses.

Now, let me be clear for a second. I want to distinguish comparative advantage from just the term advantage or what we call absolute advantage. I want to distinguish those. And the best way to distinguish those is, of course, to think about LeBron James mowing his lawn. Let's think about LeBron James mowing his lawn.

Now, LeBron James does two things, play basketball and mow his lawn. And let's assert LeBron James is better than anyone in the world at both playing basketball and mowing his lawn. LeBron James is being awesome. I mean, the guy is built, right? He can just crank on that lawn.

So let's assert LeBron James is the best person at both mowing his lawn and playing basketball. He has an absolute advantage in both activities, but he has a comparative advantage in playing basketball. In other words, he's way better-- let's take LeBron James versus me. Now there's two goods, playing basketball and mowing lawns, and two countries, LeBron James and Gruber.

LeBron James has a massive comparative advantage in playing basketball. I suck at basketball. He has a billion to 1 comparative advantage of playing basketball. Mowing lawns, he's maybe 5 to 1. He's certainly better than me at mowing a lawn. But is he more than five times? Could he do it five times faster than me? Probably not.

So LeBron James has an absolute advantage over me in basketball and lawn mowing. But his comparative advantage is basketball. LeBron James should-- and this will be the hint of where we're going. LeBron James should specialize in basketball and let me mow the lawn.

Now, in fact, I shouldn't mow the lawn either because let's take me versus a landscape contractor, and let's do economics of lawn mowing. I am certainly better than the average landscape contractor at economics. I'm probably worse at lawn mowing. So I should then hire the landscape contractor.

It's all about comparative advantage. It's, what are you relatively better at? Now let's go back to another example. Who has the comparative advantage in computers, and why? Which country has the comparative advantage in computers, and why? Which of these two countries has the comparative advantage in computers, and why? Yeah?

AUDIENCE: The US [INAUDIBLE] opportunity cost.

PROFESSOR: Right. So what's the opportunity cost of a computer in the US? Yeah, go ahead.

AUDIENCE: 3/2.

PROFESSOR: 3/2. This is roses. For computers, the US opportunity cost is 3/2. What's the opportunity cost in Colombia?

AUDIENCE: 8

PROFESSOR: 8. So the US has the comparative advantage in computers. Give him the fist bump. Go ahead. The lower opportunity cost in computers-- the US has a comparative advantage in computers. So in this model, Columbia has the comparative advantage in roses. The US has the comparative advantage in computers.

Now let's add one more wrinkle to this example. I've already made it simple enough. I've said, look, constant marginal product of labor, one input. Now let's go further. Let's imagine these goods are in perfectly competitive markets. Let's imagine the goods are bought in perfectly competitive markets.

And let's start with a simple example of what we'll call-- it's a weird word, but I don't know why we say-- we call it autarky. A-U-T-A-R-K-Y, autarky-- it simply means no trade. I don't know why we use that fancy word. But basically, this is the secret to why economists are successful and wealthy is that we make up fancy words for really easy concepts, and it makes us sound smart.

So we call it autarky, but it just means there's no trade. In a world of autarky, each country has to produce its own computers and roses. Now let's ask, in a competitive market, let's say there's a competitive market for goods and for labor, and the wage rate is w. The wage rate in this competitive market is w.

Now, you can then tell me-- and let's say w is the same in both countries. There's a wage rate w. You can tell me what price roses will sell at in the US. At what price will roses sell in a perfectly competitive rose market with a perfectly competitive labor market and a wage w? What will be the price for roses in the US?

Well, what is price equal in perfect competition? Someone raise their hand and tell me. Yeah? Marginal cost. What's the marginal cost?

AUDIENCE: 2w.

PROFESSOR: 2w. So we know that roses, the price of roses in the US will simply be 2w. We're done. All I had to give you is this, and you can tell me the price. We know the price for computers in the US will be 3w. We know the price of roses in Colombia will be 1w.

And we know the price-- that's roses. I'm sorry. Yeah, roses in Colombia. The price of computers in Colombia will be 8w. We know all the prices simply because we know, under perfect competition, how prices relate to marginal costs.

So basically, in the US, if you cannot trade, then in the US, computers will cost 1 and 1/2 times as much as roses. The price of a computer is 1 and 1/2 times the price of roses. In Colombia, a computer will cost eight times as much as a rose. So if you can't trade, we know what the market is going to look like in each of these countries.

We know what the market's going to look like in each of these countries. So now let's imagine that we actually allow trade. Well, if you allow trade, here's the miraculous piece. By allowing trade, you create economies of scope.

Allowing trade creates economies of scope. To see why, go to figure 18-3. Imagine that both countries own-- oh, let's go to figure 183. And if both countries only produce roses-- they set their workers to work 24 hours a day producing roses, then we end up with 36 roses.

How do we know that? Well, look at figure 18-2. If both countries only produce roses, we get 36 roses, 24 in Columbia, 12 in the US. If both countries only produce computers, we get 11 computers, eight in the US, three in Colombia.

Now, but what happens if the countries specialize? What if the US only produced computers, and Columbia only produced roses? Well, how many computers would we get? We'd get eight computers. How many roses would we get? We'd get 24 cartons of roses.

If you graph that, you get a outward-bending PPF. You've just created economies of scope, not through any magic, but simply through comparative advantage yielding specialization. And that's the key insight of trade theory, that comparative advantage yields specialization.

LeBron should just play basketball. I should just do economics. My landscape contractor should just mow my lawn. LeBron shouldn't mess with mowing his lawn. I shouldn't mess with mowing my lawn. And the bottom line is, if you have comparative advantage in a certain activity, you should specialize in that activity. By doing so, you create economies of scope, which we also call gains from trade.

You create gains from trade by allowing folks to specialize. So to see that further, let's imagine that the relative trading price of computers is 4. Now, you know what the relative prices are with autarky. Once we open up the trade, it's going to depend on demand. You can't tell me in a world with trading what price is going to be. I'm going to have to introduce the demand curve.

In autarky, it doesn't matter what demand is. Perfect competition dictates this. With trading, it matters because it depends how much people want computers relative to roses, and we don't know that yet. So I'm going to make life easy. I'm going to come back to this.

I'm going to start by just assuming that the price of computers-- there's free trade. And on the world market, the price of computers equals 4 times the price of roses. I'm just going to assume that in the world market, that's what happens. I'll come back to how you get there. But for now, it's easy to just start with assuming that.

So you open up to trade, and let's assume the price for computers is 4 times the price of roses. Well, what you can see is that by specializing, we open up new consumption opportunities. Go to figure 18-4. The red line in figure 18-4 was the autarky possibilities. We saw that already.

The blue line is, with world trade at a price of 4, the trade possibilities. The blue line is everywhere outside the red line. Each country can do better with trade, or they can do no worse. So if Colombia only wants roses, they're no worse off with trade.

But if they want any computers, they're better off. Why? Because they can produce roses cheaply and trade them for computers. The US, if it only wants computers, is no better off with trade. But if it wants any roses, it's better off because it can produce computers efficiently and then sell them cheaply for roses.

So by allowing each country to specialize, we can allow for expanded production possibilities. By allowing each country to specialize, we can allow for expanded production possibilities. So basically, what this means is, as long as, with a price ratio of 4, as long as countries want some of what the other country has, you are better off with free trade than with autarky. And that's the proof. You're better off with free trade than with autarky.

And simply the magic that's happening here is simply by allowing countries to specialize, you get them to use their comparative advantage to produce more. With autarky, the US was inefficiently forced to produce roses. It's much more efficient to produce computers and trade them for roses.

So by allowing that trade, we allowed more consumption possibilities in both the US and in Colombia. Questions about that? Now, in this example, I made up the price. So let's think more generally. Yeah? I'm sorry.

AUDIENCE: So how does the comparative advantages relate to what [INAUDIBLE] trade? [INAUDIBLE]

PROFESSOR: Great question. So what I've missed from this model is the whole demand side. What they decide to keep themselves and what they decide to trade is going to depend on the relative demand for computers and roads across the countries. That's going to yield this price, which I just made up. So basically, what they're going to decide to do is going to depend on how much each country wants computers and roses.

So to see that, let's go to figure 18-5, which is a little confusing. But basically, what this says is-- let's start at point B. Let's imagine we're at point B. At point B, the price ratio is 4. Four cartons of rose yield one computer.

But let's say that at point B, there's an overall increase in world demand for computers. Folks want more computers than point B. So point B yields eight computers a day. And let's say the world in general wants more than that.

So in that case, you would move down from point B along that segment towards C. Colombia would then say, look, I'm going to start producing computers. It's relatively inefficient. But if the world really wants them, that's what I'm going to do. I'm still going to trade, but I'm not going to purely specialize.

So pure specialization is a special case. In general, countries, they'll only purely specialize under certain conditions. Generally, countries will produce some of both. But they'll still relatively specialize in the thing they have a comparative advantage in. Let me say that again.

Pure specialization only emerges as a particular case. In general, countries will shift-- once you open it up to international trade, countries will shift towards producing the goods they have a comparative advantage in. They might not go all the way. It won't be as extreme as my pure specialization example. But the direction is clear.

Now, at some point, that will end. Imagine that we get to a point where the price of computers relative to roses is 10. Imagine demand for computers is such, relative to roses, the price of computers relative to roses is 10.

Well, basically, that would say, a Colombian producer says, look, I have a choice. I can give up one box of roses and get 10 computer-- I'm sorry. Basically, if I produce one computer, it will yield 10 box of roses. If the world price gets to 10, it'll yield 10 boxes of roses.

At that point, Colombia will say, forget it, I'm just going to produce computers, too. So you can imagine a world where everyone specializes in computers. Likewise, the price of computers is low enough, everyone can specialize in roses.

So where you end up on this graph depends on the relative demands. That is much more complicated. I'm not going to model that. I go back and forth whether I should model that, but I'll take another half hour. It's not worth it. I think we can get the intuition without the model.

The basic intuition is, A, for prices in a broad range, from a price of 3/2 to a price of 8, prices in that range, there'll be some specialization. As long as you are somewhere on that PPF, there'll be some specialization. If prices get too low or too high, you won't have specialization anymore. But in general, you get specialization.

How much specialization you're going to get is going to depend on the relative demand for the two goods. If the world mostly wants computers, then the US will produce more computers than Columbia. Columbia will still produce some. If the world mostly wants roses, then Columbia will produce more roses than the US, but the US will still produce some. Questions about that?

So the bottom line is, comparative advantage yields specialization. And that yields gains to trade. So that's the thought linkage. Comparative advantage means that folks want to specialize, which yields gains from trade.

If there was no trade, LeBron would have to mow his lawn. Think about that. If there was no trade, LeBron-- LeBron still cares about his lawn. He'll still have to mow his lawn. That would be giving up basketball. We all value it many, many times his mowing his lawn. That's inefficient.

We are losing-- we are happy to trade me mowing LeBron's lawn for getting to watch LeBron play basketball. We're all happy to make that trade, probably even me. I like basketball. We're all happy to make that trade.

So by not allowing that trade, we make society worse off. That's why free trade makes society better off because without free trade, people can't take advantage of what they're best at. And that's why we like free trade. OK, questions about that?

Now, that raises the really interesting question of, where does comparative advantage come from? If comparative advantage is so important, where does it come from? It really can come from two places. As the LeBron example illustrates, the first place of comparative advantage is what we call factor endowments.

Basically, who's born with what? LeBron was born with an innate ability to be better at basketball than I am. I'm not saying if LeBron never tried, and I spent my whole life, I couldn't be better than him. But he has an enormous advantage physically over me in playing basketball, his factor endowment.

Likewise, Canada was endowed with massive amounts of forest land, so they have a comparative advantage in producing timber. China is endowed with 1.5 billion people, so they have a factor endowment comparative advantage in producing labor-intensive goods. Basically, certain times, countries have factor endowments that give them an advantage, like timber in Canada or labor in China.

But comparative advantage can also be created through technology. There's no reason the US is better than-- I don't know-- Indonesia at producing computers. The US isn't that much bigger than Indonesia. But we've pushed along the technological frontier, largely through investing in human capital, to give ourselves a technological comparative advantage.

Comparative advantage versus Indonesia does not come from anything innate. It's nothing about the land of the US that makes us better at producing computers. You don't grow anything. We're better because we've moved further along the technological frontier.

So comparative advantage can be innate, or it can be produced. And that is why a huge debate around international trade is basically, how do we get ahead of other countries? If you think about President Biden's CHIPS and Science Act, a lot of what that act did-- it put $52 billion into subsidizing the production of semiconductors in the US.

Many of you may not know about the semiconductor market. China's semiconductor market-- while semiconductors were invented here in the US, and we still lead technologically in the innovation in semiconductors, we don't produce semiconductors. Indeed, a somewhat scary fact, if you follow geopolitics, is 75% of all semiconductors in the world are produced within 100 miles of China.

Now, if you think that you're worried about a war with China, then that's kind of a worrisome fact. Moreover, there's the view that, gee, we don't have a comparative advantage in trading semiconductors because China produces them all. What if we produce semi-- what if we invested in the technology of manufacturing? Rather than investing in the technology of invention, what if you invest in the technology of manufacturing?

If we got better at manufacturing than China, then we would have a comparative advantage in producing semiconductors, which not only would help our national security, would be a vital economic victory. And that's the idea of the CHIPS and Science Act is, let's put money into investing in cutting-edge manufacturing, not just for economic security, but eventually give us a technological comparative advantage.

So that's another source of comparative advantage. But there's a third source. I should have said three. There's a third source, which is not so happy. And we might call it-- I don't know of a good label for it. But we'll just call it destructive routes, destructive routes to competitive advantage.

Let me give a simple example. One reason that China has a comparative advantage not only in things like producing textiles, but producing things like batteries, is because they have really weak environmental regulations. So in the US, if you want to set up a battery factory, you have to pass a battery of tests to show that you're not doing environmental damage, you're not harming the people around you. In China, you don't.

So in China, one of the leading battery manufacturing plants was leaking the materials that are made to use batteries, and many hundreds of people died or got sick in the nearby villages. Now, China had a comparative advantage at producing batteries, so they could do it more cheaply than we could. So we're buying Chinese batteries. But at what cost? At the cost of making our environment worse and harming people around them.

You can go further. We often heard the term sweatshops is a term you hear, the idea of people who are getting poorly paid to do hard jobs. Many people would argue that China has a comparative advantage in producing things like textiles because their workers are working in terrible conditions and leading horrible lives.

Now, we'll come back to that next time and ask if that's really a valid criticism. But other people might call that a destructive route. Or think about child labor. In the US, child labor is banned, rightly. In other countries, it's not. So if other countries use child labor as a way to get a comparative advantage, we might not like that so much.

So that's where we start to-- next time, we'll get into this more. That's where we start to see, gee, maybe free trade isn't all it's cracked up to be. If the way you get comparative advantage can be destructive, then maybe we're a little worried about free trade.

We add on top of that the fact that free trade means that we get cheaper roses, but people in the US lose their jobs, and we care about jobs. That's another reason it might be a little worried about free trade. So next time, we're going to start to ask, how do we think about the welfare economics of free trade? And are there arguments against it? And what should governments do if they don't feel free trade is working to the best advantage of the world? We'll go there next time.