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**PROFESSOR:** Hi, and welcome back to the 14.01 problem solving videos. Today we're going to do Fall 2010 problem set 6, problem number 3.

Moldavia is a small country that currently trades freely in the world barley market. Demand and supply for barley in Moldavia is governed by the following schedules. The demand is given by quantity demanded equals 4 minus  $p$ . The supply is given by the quantity supplied equals  $p$ . And the world price of barley is \$1 per bushel.

Part A asks us to calculate the free trade equilibrium price and quantity of barley in Moldavia. How many bushels do they import or export, and on a well-labeled graph depict this equilibrium situation and shade the gains from trade relative to the autarkic no trade equilibrium in Moldavia.

So what we're going to be doing in this problem is we're going to be working with three different functions. The first is the domestic demand. This is how much people in Moldavia want barley. The domestic supply tells us how much the suppliers within the country are willing to supply. And the international price is telling us if we open up the borders to trade without any tariffs or any barriers for trade. This is what the equilibrium price, or the new equilibrium price will become.

So let's pretend for a second that we're in autarky where there's no trade at all. In that case the supply function, which is our domestic supply, and demand function are going to be equal. And in this case we're going to have a quantity supplied that'll be right here at the equilibrium point.

Now what's going to happen is that we're going to have the international price come in when we open up our borders. And it's going to function like a price cap. So instead of the price being way up here when we only have domestic suppliers, we're going to see that the price is going to shift down to  $p$  equals 1 to the equilibrium price.

And what's going to happen is consumers are going to be able to consume more out to this

point which we'll calculate. Suppliers domestically will only be willing to supply a quantity at this point. And that means that all of this in the middle, which in earlier problems we would have thought of as the excess demand. It's no longer excess.

These consumers can actually get a product. And the way they're going to get this product is through imports. And we need to calculate how much people are going to demand, how much the domestic suppliers will produce, and what the difference is made up by the international importers.

So to start off, let's think about what's going to happen when we have free trade. Well in free trade we're going to start off with our demand function. And instead of setting this demand function equal to the supply function, we're just going to plug in the international price for the free trade scenario.

So we can see that in free trade people are going to demand three of the products. Now at the price of one, however, the suppliers aren't going to be willing to supply these three. So we can calculate how much they'll actually be willing to supply at the price of one. So just plugging in the price we find the quantity that they're willing to supply is going to be equal to 1. So that means that the difference here is going to have to be made up by imports. So importers are going to be equal to 2.

Now compared to the autarky scenario, what we had is we would set the quantity demanded equal to the quantity supplied. And we would have found that the price would be equal to 2 and the quantity supplied would have been equal to 2. Now we can represent on the graph in this autarky situation. I'm going to outline in blue what the total consumer and producer surplus would've looked like.

So we would have had a consumer surplus which would have just been the space below the demand curve up until the equilibrium price of 2. So this would have been our consumer surplus. And we would have had a producer surplus up to the price. It's a triangle up to the price but above the supply curve.

So the total surplus beforehand was this box. Afterwards what we're going to have is we're going to have a new consumer surplus because more people are accessing the product. So our new consumer surplus is right here.

Our new producer surplus is this triangle out here. And looking at our graph, the only

difference between the free trade scenario and the autarky scenario is this box right here that I'm shading in.

So you can see that what actually happened here conceptually is that the domestic producers were worse off. Their producer surplus decreased. But the consumer surplus increased so much that overall, the total surplus within this country increased by an amount equal to the area of this box, which we could calculate if we needed to.

Let's go ahead and move on to part B. Part B says the prime minister of Moldavia, sympathetic as always, believes he can help those hurt by free trade in barley relative to the situation and autarky. He taxes the party that has benefited from free trade equal to the amount per bushel that is the difference between the autarkic price of barley, which we calculated right here, the difference between that price and the free trade price of barley, which is equal to 1.

Furthermore, he rebates the entire government revenue of the tax back to the party harmed by free trade. In a new, well-labeled diagram show the post-tax equilibrium situation. Calculate and show the new equilibrium price and quantity of barley in Moldavia, the changes in the quantity of imports or exports, the amount of revenue collected by the prime minister, and who pays the larger burden of this tax, consumers or producers in Moldavia and why.

So there's a lot of things that we need to answer in this problem, but the first step is going to be to really think about how this tax is going to affect the equilibrium that we calculated. And so this tax is going to be paid by the group that benefits. So looking at our graph we said that the consumers are benefiting. We saw that their consumer surplus changed from this triangle to the much larger triangle. So they're going to be the group that's paying this tax.

So we're going to have a new domestic demand curve for this scenario. And so we started with our demand curve of  $q_d = 4 - p$ . I'm going to get the inverse demand so that it's  $p = 4 - q_d$ . And now instead of their inverse demand being equal to this, we have to add in the tax. So the demand curve is going to shift so that  $t + p = 4 - q_d$ .

So basically when they think about how much they're willing to buy, it's going to be reduced. The whole demand curve is going to shift down by the amount of the tax. And so we can represent this graphically.

The demand curve is going to shift down an amount equal to the tax. I'm going to put  $d_t$  represent the demand curve after the tax. And the distance from here, from our initial

equilibrium, down to where the demand curve is now is going to be equal to  $t$ .

And so we can go ahead since we know the tax is going to be equal to the difference between the autarkic price and the free trade price, or  $2$  minus  $1$ . We know that  $t$  is going to be equal to  $1$ . So now we have a new equation for our quantity that's demanded. And we can again set, since we are still open up to trade, we're going to set the price equal to  $1$  and we can solve for the new quantity demanded.

So in this scenario since we're taxing the group, they're not willing to buy as much. The quantity that they're demanding has shifted from  $3$  down to  $2$ . And how we can represent that is initially we had the international price right here at  $p$  equals  $1$ . So in our initial scenario they were demanding  $q_d$  and domestic suppliers were supplying at  $q_s$ . And now in the new scenario what we're going to see is see that the  $q_t$ , or the quantity that's demanded with the tax, has shifted down because of the tax shifting the demand curve down as a whole.

Now the last thing, or the other things that this problem asks us is how much tax revenue are they going to receive and how are the imports and the domestic supply going to change. Well the quantity that's supplied by domestic producers given that the demand is still above  $1$ , the quantity that's going to be supplied in this new scenario is still going to be equal to  $1$ .

And what we're going to see is this reduction in demand is only going to affect the importers. So before, we had  $3$  and then minus  $1$  for the amount that's supplied. Now instead, the imports are going to be reduced by  $1$ . And a total tax revenue that's going to be collected is going to be equal to the quantity that's demanded times  $t$ . So we have that the total tax revenue in the situation is equal to  $\$2$ .

So in part A we saw a scenario where we calculated and looked at what quantity was supplied and what price was given when there was no free trade at all. When it was complete autarky. Now what we're going to do is we're going to look at the free trade scenario where there's the tax. And we're going to specifically look at the producer surplus. We're going to compare the producer surplus in autarky to the producer surplus when there's free trade but they're receiving the  $\$2$  rebate from the government.

So part C asks us, are the free trade losers better off or worse off after the rebate than they were under autarky and why. Let's start off by drawing graphs to represent both of these scenarios. In autarky what would happen is there would be no international price. And instead we would just have the equilibrium price right here, with a quantity demanded of  $2$  and a price

of 2 as well.

So in the autarky situation we can calculate the producer surplus as this triangle right here. To calculate the producer surplus in autarky it's just going to be  $1/2$  times 2 times 2. So beforehand, the producer surplus, the area of this triangle, is equal to 2.

Let's look at the scenario after they're open up to free trade but with the producers getting that \$2 rebate from the government. So in this scenario, the international price of one caps the price that the suppliers are going to get. And so the suppliers in this scenario are also only going to supply a quantity of one as well.

So the producer surplus in this scenario is a smaller triangle. But the added benefit is that a chunk of the producer surplus, the \$2, is also being added in to the producer surplus that would have existed under free trade. So we're going to calculate the area of this triangle, add in the \$2 government rebate to get the new producer surplus in the free trade situation.

So normally the area of that triangle would only be  $1/2$ . But since we're adding in the government rebate of \$2, we find that in the free trade scenario the producer surplus has increased to 2.5. So since the producer surplus increased to 2.5 we can say that the producers are better off under the free trade system with the caveat that they're receiving a government revenue or a tax.

So to quickly summarize the parts of the problem that we saw. What we saw here is we looked at the autarkic situation where there's no free trade. And then we looked at how producers and consumers are affected when borders are open up to free trade without any government intervention. After that we saw what happens when the government has a policy of taking away from the group of consumers or producers that benefit and giving set revenue back to the other group. And we compared the producers' surplus before and after the new government intervention.