

[SQUEAKING]

[RUSTLING]

[CLICKING]

RICARDO

CABALLERO:

Let's start with the Mundell-Fleming model. Now, this is a model that I think is extremely useful. And in the short term it will be important for you because probably 70% of the quiz will be related to things, to this model. Meaning, we're going to use this model for different things. But if you understand it well, you probably have 70% of the last quiz under control.

So I'm going to go very slowly over it. And please stop me if there is any step you don't understand. I put steps into myself so I don't rush. Because again, I think it's important to understand things. So here you have the exchange rate, two exchange rates. The white one is the euro dollar exchange rate. I'm quoting it the opposite of the way it's normally quoted. There are some conventions in effects markets. But this is, as we have defined in this course, if it goes up, it means an appreciation of a local currency. That is the dollar.

That is, you get more of the foreign currency per unit of the domestic currency when it goes up, and down is a depreciation. And you see there that-- this is the dollar became a gain value relative to the euro through all this period. And then it has lost quite a bit of value since sort of late 2022, with respect to the Japanese yen. That's the blue line. The whole cycle is even more dramatic. Big appreciation of the dollar. Depreciation of the yen. And a reversal since late 2022 and so.

So what is behind this big fluctuations? Many things. Effects are volatile, like almost any asset price. But one of the main drivers of these fluctuations is perceptions about interest rate policy in the different parts of the world. So the reason we have seen a lot of this decline here-- the reason for the rise here of the dollar is mostly because investors in general perceive that the US was more advanced in its business cycle. It began to tighten interest rates before the rest of the world.

And since interest rates were rising in the US, that led to an appreciation of the dollar by a mechanism that I describe at the end of the previous lecture., but I'm going to repeat today. Remember when I talk about the uncovered interest parity condition. Well, it's related to what I'm talking about here. And when I, again, go again over that.

And a big reason for the decline more recently is simply that there is a sense that monetary policy is peaking in the US in terms of tightness while the rest of the world is catching up. And in the case of Europe, more than catching up because they have further supply shocks coming from energy shocks and so on. So if you look, for example, at the expected policy rate path, in the case of the US, nowadays it looks like this. So the steel markets expect some hikes in the US, but a limited amount of hikes and then they expect quickly the Fed to start undoing that.

That's what this path is telling you. This is expected policy rate path. What the market thinks now, the policy rate will be in the next meeting, two meetings from now, three meetings from now, four meetings, meetings of the FOMC from now. OK, well, if you look at the same picture in Europe, it looks like that. It's clear that there still is more ahead. And you see that. That's what the market perceives at this point.

Whether that ends up being true or not doesn't matter. At any point in time the exchange rate is determined by what the markets think. So what actually happens is less important for an asset price. An asset price is a lot about pricing today things that you expect to happen in the future. But what you expect is what matters, not what actually happens. And at this moment, the market expects the Euro area to go through a more prolonged period of hiking, interest rate, hiking.

Japan hasn't had hikes in interest rates for three decades. But even now, you begin to see some-- the scale here is very small. These are a few basis points. But even the point I'm trying to make is that certainly people expect interest rates in the US to go down relative to interest rates in Japan. Not to say that the interest rate in the US will be lower than the interest rate in Japan, but the direction of the change is in that way. So relative to where we're at now, the direction of the change is towards the US loosening monetary policy before the rest of the world does.

And that's what is leading to these big swings. I said before, this is a period in which the US has to start tightening before the rest and the currency appreciated a lot, especially with respect to the yen. Because again, the yen has been against the zero lower bound for a very long time. So nobody expected the yen to move, to follow the US. And with respect to Europe, well, Europe was having inflationary problems and so on, as well. So people expected it to follow the US at some point.

For Japan, there was nothing like that. And that's what led to a massive depreciation of the yen, appreciation of the US dollar vis a vis the yen. So what the Mundell-Fleming model is about is about first connecting these things, trying to understand what moves the exchange rate, how the different monetary policies in different places or different policies in different places of the world affect the exchange rate. And then it's about understanding how those exchange rate movements affect real activity in the short run that's what the Mundell-Fleming model is.

So it is really, we're going to go back to our old IS-LM model, very short run. We're going to even fix nominal prices and so on. So back to that environment. But we're going to do it in an open economy. So we're going to have a new variable floating around, which is the exchange rate. And we need to understand how the exchange rate moves when different things happen in different countries and what is the impact of that on aggregate demand, and hence, on output-- we're talking about a very short run in the different parts of the world.

So that's the plan. That's what we intend to do. So let's start with the Mundell-Fleming model. Remember, we wrote down the equilibrium in the goods market in the previous lecture. And I'm just reproducing what I wrote in the previous lecture. So it looks exactly like the closed economy. Output is being determined by aggregate demand. But it's aggregate demand for domestically produced goods.

Domestically produced goods is not the same as domestic demand for goods, which is this, because now there is a net export term. So part of the things that residents demand, they demand from the rest of the world, not from domestic producers. And at the same time, part of the demand perceived by domestic producers comes from the rest of the world, from exports, not from domestic producers. So that's the reason we got an extra term here, which is this net exports.

And we said this net exports is a function of three things. It's a function of output. So it's a decreasing function of output. Why is that-- of domestic output? Domestic output. Domestic income. Why is it a decreasing function of domestic income? Why do net exports decline when domestic income rises?

AUDIENCE: People might be more inclined to buy imports.

RICARDO They import more. They consume everything more. But part of that is import. And so part of that energy of the
CABALLERO: extra demand goes to foreign goods. And that's what deteriorates net exports. And that's the reason, had we just stopped there, made the net export function just a function of output, we would have not needed all these extra parameters that I'm about to build because all that would have meant is that just we have a smaller multiplier.

It would have been exactly the same as we did in the closed economy, but with a smaller multiplier, because every time an output goes up, now part of that demand goes to foreign goods rather than domestic goods. But it's not so-- first, because we have an extra another income that matters here, which is the income of the rest of the world. But more importantly, because we also have an exchange. But let's start from this side.

So net exports is increasing the income of the rest of the world. Why is that? That is, demand for domestically produced goods rises when foreign income goes up. For an output, for income goes up. Why is that?

The symmetric argument with inputs. Well, our exports are the imports of the other country. So if the income in the other country goes up, then their imports will go up, which is our exports that go up. That's the reason net exports goes up. And the last term, remember, says that net exports is declining on the real exchange rate. Why is that? What happened when the real exchange rate goes up?

AUDIENCE: It makes our goods more expensive relative to foreign goods.

RICARDO Exactly. Our goods become more expensive relative to foreign goods, and that affects us from two dimensions.
CABALLERO: First, our exports will tend to decline because our goods are more expensive. And also, our imports are going to tend to increase because foreign goods are cheaper. And so that's the reason this is decreasing with respect to the exchange rate.

The big thing of the Mundell-Fleming model really comes from the fact that this guy is there. Had we not had the exchange rate there, again, we could have used exactly the same apparatus as we used earlier on. But we're going to have an exchange rate floating around. And that will require us to build more, a little more. We need an extra equation, because we have an extra endogenous variable.

Now, what I'm going to assume here, as we did in the first part of the course, is that both the domestic and foreign prices are completely fixed. So I'm going to ignore Phillips curve, inflation, expected inflation, and all that, and assume all that is 0. Expected inflation, inflation, zero. When I do that, the same equation, the equilibrium in the goods markets changes a little bit. I mean, it's the same equation. But now I don't need to differentiate between real interest rate and nominal interest rate because inflation is zero. So nominal interest rate is equal to the real interest rate. So I'm going to stick in here the nominal interest rate.

Second, I really don't need to differentiate between real exchange rate and nominal exchange rate because the relative prices, the prices themselves are not changing. And so all that will move the real exchange rate is the nominal exchange rate. So that's the reason I'm going to write here the nominal exchange rate is because it's the only thing that will move this variable around given that prices are fixed.

So our equilibrium in the goods market. And this is the thing you need to compare with lecture three or something like that. And as I said, this part here only lowers the multiplier, so not a big change. This one here is an extra parameter that shifts aggregate demand up and down. So you can treat it almost like we treated [INAUDIBLE]. Remember, as the consumer confidence goes up, then aggregate demand goes up. Well, here we have the rest of the world's output goes up. It does exactly the same, the same analysis.

The problem we have, though, is that we have an extra variable here, which is the exchange rate. And that's an endogenous variable. So we're going to have to come up with some other equation to solve for that equation here. In lecture 3 or 4, what we did is, OK, we said we have two endogenous variable, output and the interest rate-- output and the interest rate. We need one more equation.

Well, the other equation was just monetary policy that set the nominal interest rate. Here, that's not going to be enough because we also have an exchange rate floating around. So we need to bring another equation here to deal with this new endogenous variable. What is that extra equation? Well, it's the uncovered interest parity condition. Remember, it's the last expression we had in the previous lecture that takes this form.

Before I simplify lots of things, I wrote this down. And it says that the exchange rate is equal to that. Now, what is this? Where does this equation come from? What is it trying to do? Remember, we talked about this in the context of say, well, you know, when you open goods markets, then you need a relative price to decide what you're going to buy. That's what the real exchange did.

And then we open the capital account. And then people need to decide where are they going to invest their money. And that equation was related to that.

AUDIENCE: Expected rate of return has to be the same for domestic.

RICARDO CABALLERO: Exactly. It's what equalizes expected rate of return. In equilibrium, that has to happen. Again, in reality, there is risk adjustment. There is lots of other factors that we're removing from here. But absent those other factors, the returns have to be similar in both places because if one asset is giving more return than the other expected return, then people are going to invest all their portfolios in that asset.

And what happens is those flows that try to go to those assets that give the highest return end up equalizing expected return in equilibrium. And that's the equation that does that, exactly that. How do I know that?

Well, remember, I can divide this by the exchange rate on both sides. And then what you get is 1 equal to a numerator that has the nominal exchange rate times the expected appreciation of the currency. And in the denominator, you have the foreign interest rate. And so when you compare the two, you have to compare one base interest rate, the domestic or the foreign, plus the expected appreciation of the appreciation of that currency. And that's what this term is doing here, this divided by that.

Good. So what do we get out of this? One thing we're going to do for quite a while, because it will simplify things a lot, but sometimes also lead to confusion in the way we understand why currencies depreciate or appreciate. But we'll pause and I'll remind you of this repeatedly. We're going to assume for now that the expected exchange rate for $t + 1$ is fixed. And until I tell you otherwise, we're going to make this assumption.

Now, that's a huge simplification, completely unrealistic, and so on. But it will help me explain the mechanism. I mean, one of the things that moves exchanges a lot is that people have lots of expectations about future exchange rates. We'll get to that later.

But for now, so you understand the mechanism, how the Mundell-Fleming model works, I'm going to assume that we all know what the expected exchange rate-- we all have a common expected exchange rate and it's fixed. We may move it as a parameter. But I'm trying to say, I'm not going to endogenize that. I'm going to take it as fixed. And I may move it around to show you what happens when that changes. But I'm not going to endogenize it.

Otherwise, I need more equations, one more. I want to stop this sequence of equations that I would have to build. Later we'll understand more that, what I just said. But for now, just take this as fixed. So if I take this as fixed, now I have an equation. Remember, I was looking for an equation here for my exchange rate. Once I do that, then I have what I want. I have an equation for my exchange rate today. It's just a function of domestic interest rate, international interest rate, and the expected exchange rate.

So I know the following, for example. I know that an increase in the domestic interest rate, other things equal, appreciates exchange rate. I can see it in the equation. If I move the domestic interest rate up, the exchange rate goes up. That's an appreciation. The dollar becomes more expensive. Even simpler.

Suppose we start with a situation in which the domestic and the international interest rate were the same. And now I increase the international interest rate. And I'm saying the exchange rate will appreciate. Well, first of all, let me start with something even simpler. Suppose that this interest rate is equal to international interest rate before analyzing the change I'm about to analyze.

Then from this equation, what do I know about exchange rate? What is it equal to? If the domestic interest rate is equal to international interest rate, what is the exchange rate today equal to? The expected exchange of next year. If I have the same interest rates, I cannot expect a capital gain or loss on the currency position because I have already an equal interest rate in the two bonds.

So then I'm starting from a situation where the current exchange rate is equal to the expected exchange rate and these two are equal. And now I'm going to increase the interest rate, the domestic interest rate. And it's very easy for you to read from here that the exchange rate will go up. The currency will appreciate. Why? This is not an easy thing to answer unless you have read the book or something.

AUDIENCE: The interest rate goes up, then money supply should go down, which would generally increase the value of money.

RICARDO Nope. No money here. That money is only related to the mechanism we use to increase interest rate. But I'm
CABALLERO: saying just use that equation and the logic behind that equation, the uncovered interest parity. Why is it that if we went to financial situation which interest were the same, now I increase the domestic interest rate. I'm saying the exchange rate has to appreciate.

AUDIENCE: [INAUDIBLE]

RICARDO No, no, but that's a description of-- yeah, we know that. The question is, what is the logic? Yeah, we know the
CABALLERO: result. What I'm asking is for an economic explanation for that result.

AUDIENCE: More people will want to invest in the currency, using currency, so the demand goes up and [INAUDIBLE].

RICARDO Well, if you go to Wall Street, [INAUDIBLE] they will explain it in those terms. It's not the right explanation. But
CABALLERO: they will explain it on those terms. And there is some logic behind that because this equation assumes that the arbitrage happens instantaneously. Immediately things move.

But before that happens, some people will start buying more of the one that has more return. But this equation already solves all that. And that's when this assumption matters. And it's a little annoying. It bothers me for a variety of reasons. But we're going to use it to understand the mechanism.

You see, if I keep the changes fixed, we start with a situation where the exchange rate was equal to the expected exchange rate. If I keep it fixed and I appreciate the currency today, then what do I expect to happen to the dollar-- let's talk about the dollar-- from this period to the next one.

Remember, we start from a situation where the exchange rate was equal to the expected exchange rate. Now I increase the interest rate and I said the exchange rate appreciates. Then what do you expect the exchange rate to do over the next period? If I have a move expected exchanger, now the exchanger moves above the expected exchange rate, what do you expect the exchange rate to do? Exactly. It has to depreciate.

So the reason the depreciation happens here is because you need to expect depreciate the dollar from this period to the next one. Why do I need to expect the exchange rate to depreciate? So not appreciating the currency, in equilibrium, I need to expect to depreciate. That is, I need to expect to lose money on the currency part of the trade. Why is that? Confusion is good. You learn from that. And this can be very confusing, I know. What is this equation trying to do?

We are trying to make the spectral returns the same. That's the whole idea of this. So if I am now telling you that one bond is paying a higher interest rate than the other one, I need to offset that somehow. How do I offset it by expecting a depreciation of the currency of the bond, that is, the bond that is denominated in the currency that is expected to depreciate?

So what I need to do is compensate for the interest rate differential with an expected depreciation of the currency that is paying a higher interest rate. So that's what, in this model, when I fix the expected exchange rate, the only way I can do that is by appreciating the currency today so I can expect it to depreciate in the future. That's the logic.

Now, what is the connection with Wall Street? They will tell you, well, before this may happen not instantaneously. It happens somewhat slowly. So traders immediately will go to the US dollar bond because they see that they have a higher return. And it will be the case until the currency really appreciates.

Once the currency appreciates enough, then that advantage disappears. That's what this condition is doing. It's making the spectral return the same. But in the process of the exchange going from the initial exchange rate to the new equilibrium exchange rate, there may be an opportunity there. And that's when you start seeing these flows. That happens very, very fast. But that's when you can see some of those flows.

I mean, in this market, that happens very, very quickly. So what is typically wrong is that then an analyst comes and tells you, explains the story, why the exchange rate is going to continue to appreciate. Well, that's just way too late. You're already in this environment. You lost the trade.

What about an increase in the foreign interest rate, I star? So an increase in the foreign interest rate, let's start from the same situation we had before. We start from interest rate equal to international interest rate. Therefore, the exchange rate is equal to the exchange rate. And now the foreign interest rate goes up. What is going on now in the US. The US is sort of stabilizing here. And Europe is beginning to hike a little more than the US.

So we know from the equation that means the exchange rate will fall. That is will drop here. So that means the exchange rate is depreciated and the dollar is depreciating. Why is the dollar depreciating?

AUDIENCE: Needs the same mechanism that you described previously, except replacing E_t with 1 over star key.

RICARDO
CABALLERO: Yeah, that's correct. I mean, the issue here in terms of the economics is that, remember, if we start from the same interest rate and now all the [INAUDIBLE] I'm giving you doesn't need to start with the same interest rate. It's just simpler to start from the same interest. But suppose we start with the same interest rate. And now we increase this one.

Then that means the foreign bond is paying a higher interest rate than the domestic bond. I need to equalize the spectral returns. The only way I can do that is by having an expected appreciation of the dollar. Since the expected exchange, we fix it here. The only way I can give you an expected appreciation of the dollar is by depreciating the dollar today.

So this is the same mechanism. The same logic is symmetric. That's the mechanism. Now, is this true that in the very short run, when I^* goes up and I doesn't move, then lots of people go and buy foreign bonds. And that produces sort of demand for euros and blah, blah, blah, blah. But that's very quick. Machines do it for you now. So it happens very quickly.

So this equation shows you what happens after all that mess has already cleared, which happens in milliseconds. OK, what if I change expected exchange rate? So again, I'm fixing it. But I can move it around. I'm treating it as a parameter. When I say I fix it, I just don't want to endogenize it. I don't want to make it another endogenous variable.

So what happens here is the exchange rate, we start with the same situation we had before. Now the expected exchange rate goes up. Well, from the equation it's very clear. The current exchange rate immediately rises-- one for one, in fact. If I have these two interest rate at the same. And now I move the expected exchange rate up, then the current exchange rate immediately jumps.

So if we expect the dollar to appreciate in the future, then it depreciates today. Why is that? Expectations are very powerful in financial assets in general. This is the first time you come. And we'll talk a lot more about that in the next week. But you can see it here.

So if I move the exchange rate today up, the expected exchange rate. It means expect the exchange to be-- we know today the dollar is \$0.90-- 0.9 euros per dollar. Well, suppose I expect 1 euro per dollar in the next period. What will happen to exchange rate today? Well, it jumps today to 1. Why is that?

AUDIENCE: The dollar will be more expensive to buy later. So people are--

RICARDO OK. That's your friend, the trader there. Yes, that's true. That's true. What does that mean, though? It is true. It's

CABALLERO: more expensive. But why did you want to buy it to start with? I mean, who cares that something is more expensive. You are not planning to buy it.

AUDIENCE: Because the current price or something also has to take into account the future price.

RICARDO That's what the equation says, yes.

CABALLERO:

AUDIENCE: Because it's part of it. Because its value, at the present moment, takes into account some of its value in the future.

RICARDO This is an arbitrage type relationship. And what I suggest is whenever you come across an arbitrage type

CABALLERO: argument, you ask the question, well, suppose not. Suppose this didn't happen. What would then happen? What would look odd?

Almost any arbitrary, that's a good way of thinking about this. The equation tells me that the exchange rate has to jump right away. But suppose not. What goes wrong? Well, I think that's the way, the easiest way to think about any of these asset pricing in general, by the way.

Well, suppose not. Suppose that the expected change that goes up. The interest rates haven't changed. And the exchange rate today doesn't move. What happens then? Remember, we're in a situation with both interest rates are the same. Now, the expected changes went up by 10%, say.

And the current exchange rate hasn't moved. I'm sure between the two of you, you can design this trade. What do you do?

AUDIENCE: Everyone would buy foreign bonds in the next period. And no one would in the first period.

RICARDO No, no. But what did you do today? Suppose you're a trader. And now you see, whoops, the exchange, the dollar

CABALLERO: will appreciate 10%. The interest rates are the same. And the exchange is not moving today. What do you do? Which bond do you buy?

AUDIENCE: Buy a lot of American bonds.

RICARDO Of course, because you have a 10% expected capital gain from buying that bond if that doesn't happen. The two

CABALLERO: bonds are paying the same interest rate. And now I tell you, well, yeah, but one is going to appreciate by 10% relative to the other.

So clearly, you go short massively the foreign bond. And you go very long the US bond. That's what you do. We all want to do the same. So it happens very quickly. And the changes appreciated today up to a point in which that incentive is no longer there. And in this particular case, if the interest rate are the same, that will happen only if the exchange rate jumps exactly by the same amount as expected appreciation of the-- expected value of the dollar change in the future.

Think about this. Play with these things. I know it can be confusing. And I always start with let me move something. The equation tells me this is what has to happen to the exchange rate. Well, suppose that didn't happen to the exchange rate. And then you say, then I clearly invest in this bond. This dominates the other one.

Well, that condition tells you no, no, in equilibrium you have to be indifferent. So the only thing you can move is exchange rate. And the exchange has to move until you are indifferent again after you have done some change, some argument on the right hand side. That's the way you need to think about it.

So here I'm just plotting this relationship in the space of exchange rate in the x-axis and the domestic interest rate here. So that's an upward sloping relationship. You can see here that as I move the interest rate up or the other way around. But anyways, if I move the interest rate up, the exchange is going up. So that's a positive relationship.

I can do it the other way around. As I move the exchange rate up, then the domestic interest rate has to go up. I'm taking as parameters, the foreign interest rate and the expected exchange rate. If I take as parameter this and that, then I have a positive relationship between the exchange rate and the domestic interest rate.

So that's going to be-- I'm plotting the UIP and covering parity condition. Notice this point here is interesting. This point tells you that when the domestic interest rate, i , is equal to the International interest rate, then the exchange rate has to be equal to the expected exchange rate, which is the question I asked before.

Remember, I asked you a question, let's suppose that we start with an interest rate that is equal to the International interest rate. What is the exchange rate? And you said the answer was, well, it has to be equal to the expected exchange rate. That's that point here.

If the interest rate, domestic interest rate, is above that, the international interest rate, then the exchange rate today has to be above the expected exchange rate because that will give you a expected depreciation of the currency, which will compensate for the fact that the domestic bond is paying a higher interest rate than international bond.

Conversely, if the domestic bond is paying a lower interest rate, then the exchange rate today is very depreciated because you have to expect it to appreciate in order to compensate for the interest rate differential. Probably not. But this requires practice, I tell you.

OK, so now we have an equation for the exchange rate at least. So I can go back to my IS equation in the open economy. And I have an equation for the exchange rate. So I replace it. This is nice because I have two new parameters, expected exchange rate and international interest rate. But now this is also a function of the interest rate. So at this moment, I have one equation and two unknowns, really, after I solve out for the exchange rate.

I have one equation and two unknowns. The two unknowns are output and the domestic interest rate. All the rest are parameters. So that's the same situation we're at in lecture 3 or so. So then we need an extra equation. The extra equation was monetary policy, the LM. We're going to do exactly the same here.

LM is the same. It's the domestic central bank sets the interest rate. So now I'm set. Now we have the IS-LM model in the open economy. This is the Mundell-Fleming model. That's what the Mundell-Fleming model is. A more complicated IS with a UIP, a driven exchange rate. And then the LM is the same as in the closed economy. So this is the Mundell-Fleming model.

So one thing we know already, we knew from the previous lecture, that we have a small multiplier in the open economy because we have the inputs that are also responding to output. We have a new parameter. But now we also know that an increase in the interest rate-- so monetary policy in the open economy-- has two effects now. It used to have only this effect. Remember, it affected domestic investment. So an increase in the interest rate would lead to a reduction in aggregate demand because investment would fall.

Remember that was the role of the interest rate. That's the way monetary policy works in the closed economy, was through this channel here. Now we have a second channel, which is this one. So when the interest rate goes up, it's contractionary for two reasons. One, for the reason we had before, which is that investment falls. But there is a second reason it's contractionary. What is that second reason?

I mean, there's only here. It's only second-- yeah.

AUDIENCE: Raise the exchange rate.

RICARDO
CABALLERO: Because appreciates the exchange rate. And when you appreciate the exchange rate, net exports decline. So more domestic consumption is diverted to foreign goods. And less foreign demand is allocated to our exports. So that's the second channel.

So in an open economy-- and the smaller is the economy, the more important is this term, the more powerful is that channel. The US cares very little about this effect. Most other economies care a lot about this effect. Because the US is a relatively closed economy, believe it or not.

So this is the start diagram of the Mundell-Fleming model. So this thing here is our old IS-LM model. It's just that this IS is a little thicker now. It has net exports in there and so on, but it looks exactly the same. That is, plot equilibrium in financial and goods market, the combinations of output and domestic interest rate that are consistent with equilibrium in both markets.

That's the case here. This is IS, which is all the combinations of domestic output and domestic interest rates that are consistent with equilibrium in goods market. This is the interest rate that is consistent with equilibrium in financial markets. That's what the Fed does in the US. That point is where both markets are in equilibrium.

But we can take this interest rate. So that's what will happen. The interest rate will be, in the US, the interest rate is set by the Fed, not by the ECB. The Fed will set the interest rate. That will give us some equilibrium output. And then we can go to the UIP condition, you see, I'm plotting here, and figure out what the exchange rate is.

Because for this interest rate here, there's going to be some point in the UIP. And that tells me exactly what the exchange rate is. So with this set of diagrams, I can determine the interest rate output and exchange rate. So I can study the effects of different policies, for example, on output, the interest rate, of course-- that's the policy itself-- and the exchange rate. So this is the new thing I can explain. I can do a little bit of asset pricing here. I can explain the behavior of the exchange rate, as well.

So this diagram-- I mean, you need to really control very, very well. So I'm going to play with it quite a bit. Monetary policy. Let's do monetary policy. We talk about monetary policy already. So suppose that for whatever reason, the domestic economy, domestic central bank, decides to hike interest rate.

Suppose the economy was overheating, output was too high relative to natural rate of output, the typical reasons why you need to raise interest rates. And so suppose that the domestic interest rate goes up. Well, as it used to be, that's going to be contractionary. What happens to the exchange rate?

Well, I know the interest went up. I look into my UIP. For the high interest rate and a current exchange rate that is above-- that has to go up relative to all. When I increase interest rate from here to there, then my exchange rate has to appreciate. Why is that? So an expansionary domestic monetary policy will lead to a contraction in output, which is what we get out of a monetary policy. But it will also lead to an appreciation of the currency. Why is that?

That's what we just discussed, UIP. If I move the domestic interest rate and the rest and the rest of the world does not follow me, so we move interest rates, they don't, then now I need to compensate for this increase in the interest rate differential. And the compensation will come through an expected capital loss through the currency. So if I appreciate more the currency, since I haven't moved the expected exchange rate, I expect a larger loss from the point of, from the countries from the currency side.

That's what has happened here. So that's what is behind depreciation. And, of course, the depreciation is already built in here, which is what makes monetary policy more powerful than the closed economy because you get the next export channel. But that's built in here.

OK, here all that I did is exactly the same as we were doing in the last 30 minutes. I just use this UIP. For whatever domestic reason, I need to raise interest rate. And have contractionary monetary policy. Well, one of the effects that you're going to get in an open economy is that your currency will tend to appreciate. OK, good.

What about fiscal policy? Well, if the Fed doesn't follow, the central bank doesn't follow, and you have an expansionary fiscal policy, then that will increase output. It has no effect on the interest rate. Therefore, it has absolutely no effect on the exchange rate. So an expansionary fiscal policy, which is accommodated by the Fed-- that means the interest rate is kept at the same level-- then does not lead to an appreciation of the currency. It doesn't move the exchange rate. It no implication for the exchange rate.

Now, what about this change in output? Is it larger or smaller than the one we did in lecture 3 or 4?

AUDIENCE: It's going to be smaller.

**RICARDO
CABALLERO:** Smaller. Why?

AUDIENCE: Because it's part of the increase in [INAUDIBLE] falls on [INAUDIBLE].

**RICARDO
CABALLERO:** Exactly because yeah, it goes to imports. Perfect. OK, good. So this is smaller than it was in the closed economy. And it has no impact on the exchange rate. That is, the UIP has nothing to do with government expenditure. It's all about financial markets. It's about expected returns, things like that. So unless the fiscal policy somehow affects interest rate, then there is no effect.

What may happen is that, for example, is that treasury becomes very expansionary. And this output becomes too large for what is consistent with a zero output gap or no inflation. And then the Fed may react and raise interest rate. And that will lead to inflation of the exchange rate and so on.

And that's the reason why, in practice, when countries have sort of expansionary fiscal packages, the currency tends to appreciate, is because investors expect the Fed to react to that or the central bank to react to that and raise interest rates. But if the Fed says, no, no, we need that fiscal expansion, I'm not going to move the interest rate, then the exchange rate won't move.

So let's use a little more of this model and look at other shocks within this model. So let's start with-- suppose that we increase the expected exchange rate. What moves in this diagram? Let's go-- does LM move? No, the LM is controlled by domestic central bank. Doesn't move.

Does the IS move? When I asked you whether it moves, you should always fix something. So you say, OK, let me fix the interest rate, say, pick a point like this one. And now I have to ask the question, what happens to output now that I have moved the expected exchange? If I get the same output back, means that IS doesn't move.

If I get a different output, equilibrium output, then I know that the IS did move. So what is the answer? If the interest rate doesn't move, the foreign interest doesn't move, and expected change rate goes up, what happens to the current exchange rate? Appreciate. What happens when there is an appreciation? Net exports decline. That means that moves the IS to the left.

So this movement will move the IS to the left. That's the first effect. What about the UIP condition? Will it move or not? We have taken that as a parameter. Will it move? I mean, remember, I give you a clue because I said, we are taking these two as parameters here. So if I move a parameter, most likely I will move the curve. But in which direction will it move?

To the right. Yes, because for the same interest rate, now I need the exchange rate to move one for one, the current exchange to move one for one with the expected exchange rate. So this was the exchange rate before. And now the expected exchange moved to the right. Well, in order not to generate the expected capital gain or loss, I have to move the current exchange rate by the same amount.

And so that means this curve will shift to the right. What if I move foreign output down? What happens? Which curve moves? Well, this is not a parameter here. So this is not moving. This is not a parameter here. So this one is not moving. Only one can move. The IS, where?

AUDIENCE: It would move to the left.

RICARDO CABALLERO: It will move to the left because net exports will decline. Now, for any given level of the interest rate, now we have less net exports. And therefore the IS move to the left, so output falls. But there is no movement here. Unless the Fed reacts to that, the central bank reacts to that, it won't happen.

I mean, and it may well be the case that you want to react to that. If the whole world goes into recession, the US is very likely to lower interest rates because it's very contractionary. The whole world goes into recession. When the US goes into recession, the rest of the world, everyone wants to cut interest rates because the US is a big player. So it really drags everyone down.

The last one, I'm going to repeat this in the next lecture is, well, what happens if i^* moves up, the foreign interest rate moves up? Well, the LM doesn't move. This one will move which way? Because that was a parameter here. To the right. You said to the right. That's right.

So think what happened here. If the foreign interest rate goes, up at any given interest rate, now the domestic bond is doing worse than otherwise. So I need to depreciate the exchange rate today in order to expect an appreciation.

That means this curve moves to the left. It moves to the left because I have to expect an appreciation to compensate for the interest rate differential. So these will move to the left. What about this curve here? We solve it in the next lecture. Very good.