[SQUEAKING]

[RUSTLING]

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RICARDO J. CABALLERO: So today, we're going to talk about perhaps the most important model in this class, the IS-LM-PC model, which puts together all that we have done up to now. But before we do that, let's talk a little bit about current events. Who knows what that is? Is this exam week or what? [LAUGHS]

AUDIENCE: Silicon Valley Bank.

RICARDO J. CABALLERO: Silicon Valley Bank, exactly. So Silicon Valley Bank, the 16th bank in size, asset size, in the US went, essentially, under last Friday. It was shut down by the FDIC last Friday. So that's the decline in the stock value during Thursday, Friday. And then it was shut down, and you see that it's not been traded anymore.

So that's a pretty significant event. And the weekend was pretty stressful for anyone involved in this event-- the Treasury, the FDIC, the Federal Reserve, and so on. And it's first-- it was a large-- I mean, it's not one of the big systemic banks, if you will. It's not JP Morgan, Citi, Bank of America, one of those banks, which are regulated even differently from these banks. But it still is a pretty large bank, as you see, by asset size, $209 billion, which is comparable to Washington Mutual, which was the largest bank that went under during the global financial crisis. Great Recession.

At that time, there were lots of other banks that went under. But the largest was comparable to this one. And in fact, all the things that were done over the weekend and are still being done today is to prevent something like this happening here as well. And so it was a pretty significant event.

Now, what happened to Silicon Valley Bank? Well, in the immediate cost of the failure is what always kills a bank, which is a run on its-- by these depositors. And what you see here is the following. This is-- this bank actually grew enormously over the last two, three years, essentially doubled its asset size. But it began to have sort of outflow-- net outflows of deposits during 2022.

And the reason for that is not because the business was doing poorly or anything. It was simply because this is a bank that serves primarily sort of the tech sector-- startups, companies, and things like that. And those sectors were having a hard time raising new capital in an environment that was not very friendly towards the tech sector. So they began to withdraw on their deposits, and that's what led to these flows here.

Now, eventually, because of this and something I'll explain in a few minutes, they decided, SV Bank decided to issue new equity, issue new equity to cover certain losses they had incurred. And today, in the modern of social-- in the world of social media, that immediately led to sort of massive spread that this bank was in trouble. And then you saw enormous attempts to withdraw deposits.

Now, not all of these were fulfilled, but there was a massive pressure to withdraw the deposits. And that's the end, always, for a bank that doesn't find an alternative source of funding. And often, for withdrawals of that size, the only alternative source of funding is either that some other bank buys you [CHUCKLES] or that the Fed comes in and gives you a line.

Anyway, so what is the-- that was immediate, and it's always-- whenever you ask-- you hear about the bank run, the immediate cause of the problem is a run of the depositors from deposits in that bank. Now, why did this happen in this particular bank? Again, I explained why. You saw those small withdrawals of deposits.

But what happens to them is actually their-- as I said before, their deposits grew very rapidly over the last two, three years. And then, rather than being very risky lenders, rather than investing-- sometimes when banks grow very rapidly they do lots of crazy things. They make lots of loans without doing the due diligence process and all that.

That's not what they did. They bought Treasury bonds, the safest assets you can imagine. They bought 10-year Treasury bonds, lots of them. But they bought them at the wrong time. They bought them right before the hike in interest rates that we began to see in 2022.

And we already looked at the relationship between interest rates and price of bonds. Well, you have a 10-year bond, and the interest rate starts going up, the price of that bond starts declining. Now, that is not-- is problematic for a bank, but not entirely the end of the story, because that means that the market value of the bonds you are holding among your assets starts declining.

But banks do not need to recognize that loss unless they sell the bonds, because the logic is that, well, if the guy just sits on the bond, the bond hasn't really lost any value in the sense that it will get the same coupons that it was planning to get and so on. This is US treasuries US treasuries are not going to default on the coupons let's hope it's not going to happen in a few months from now. But typically they don't default on coupons.

So the logic-- the regulation is designed in such a way-- perhaps that is a failure. I think there is a problem there. But they don't need to recognize the losses unless they sell the bonds. So they look pretty healthy because they had massive amounts of Treasury bonds. They didn't need to recognize that.

Problem is that when these relatively small withdrawals start, at some point, they needed to find a substitute for those funds. They need to honor the deposits that were being withdrawn. And at that point, they had to sell assets.

And when they sold assets, they made the loss because, at that point, you have to recognize the loss because you're not going to hold the bond until expiration and clip all the coupons that come from it. So you have to recognize the loss. That's the loss that led the CEO to announce that they needed fundraising to cover up $2.5-billion hole they had as a result of the losses.

Now-- OK, so now we know where the losses came from. Now, if you notice, the losses are not that big. I mean, this is a bank with $200 billion, and the losses were relatively small. Where is the other leg of the problem? It's here.

In the US, deposits are insured up to $250,000. That means, no matter what happens to the bank where you have the money, if that bank goes under, and you have deposits for below $250,000, the FDIC comes and gives you a check. So there is no risk.

So you have a deposit under $250,000, you don't need to worry about this. You may go-- you don't need to read the news about this bank, because you will get your funds. In fact, when the bank was shut down on Friday, the FDIC announced immediately every deposit under $250,000 can come on Monday and get this money.

So there is no issue there. And most banks have a large share of depositors that are small depositors. That means that they are covered by this deposit insurance mechanism, which was designed precisely to prevent runs because if you don't need to worry about whether you get your money, you don't need to run on the bank.

The problem is that this bank was very different in the composition of depositors. It had primarily business deposits, meaning it was all these start up companies and so on in the tech sector. They had their deposits there. And those deposits were much larger than $250,000.

If you see, it's about-- I think it's close to 95% of the deposits were not covered by the insurance, by the FDIC insurance. That means it's a very different calculation when you have a deposit that is not covered by insurance, and then you start feeling that the bank may go under. What do you do? You take your money out, put it in some-- you send it to JPMorgan, where there is no risk, and wait until this thing is resolved.

Now, in this case-- and that's what typically happens. In this case, it happens even faster than normally. Why? Because many of the depositors, the businesses that were deposited in there, were startups that were being seeded by some venture capital funds.

And venture capital funds, as soon as they noticed that there was a problem here, began to call all the startups and tell them, hey, take that money out of there because, you know, [CHUCKLES] they may run into trouble. So it was a venture capital world that caused the run, effectively. And that's what happened, OK?

Now-- so that's what happened. That's the reason for the run. And so there was a problem. The problem was not that big, but the problem is that the deposits were very unsafe. They were not covered. And moving deposits out is very easy. I mean, you just [CHUCKLES] wire your money to another bank. So why wait there? Why risk it? And that's what happened.

It's called, in economics, coordination failure. I mean, if everyone freezes and says, OK, nobody takes the money out and so on, this stuff is going to pass, then we're safe. But since we don't call each other, and we don't trust each other to really leave the money there, we make the call only after we have taken our money out. And since we all think the same way, then you get a run on the bank.

Now, let me start connecting this a little bit with the kind of things we have done in this course. I made-- actually, this runs later in the course as a topic, crisis, speculative attacks, and things like that. But for now, here what you have is an indicator of-- essentially, this is the VIX. It's an indicator of implied volatility, something that's extracted from the price of options.

You don't need to know the details. But the point is that it's one of the main indicators of fear, of how afraid are investors in a moment in the market. And what you can see here is that this indicator, the VIX, essentially, spiked Thursday and Friday, went up-- Friday, went up very, very rapidly. And then it got stabilized a little.

Now, it turned out that-- it turns out that, over the weekend, you may have heard, the government, the consolidated government, came up with a very massive package to prevent runs on the remaining banks and also to prevent-- the fact that-- I mean, all of these were business deposits of small companies that used even this bank for the payroll and so on.

So what was done this weekend is that all the deposits, not only the ones under $250,000, were guaranteed by the FDIC. There are mechanisms in which you can activate that. So that means that now all the depositors were made whole. But the idea was not-- it was-- partly, the reason to do that, it was to prevent a mess in the payrolls of the small companies and all that that had their account in this bank. But it was also to prevent runs on other banks.

And so on top of this, the Fed now has a line of credit for banks to not have to sell their assets. For small banks, they can just pledge the assets to the central bank and get in exchange for that the cash they need. And they can do that without recognizing the implicit loss or without marking to market the price of the bonds. So had this mechanism existed before, the plunge of SVB-- we would not have seen anything like that. But the whole idea was to prevent that other banks running into that kind of trouble.

Now, the markets reacted well to all that overnight and so on. But the VIX kept going up this morning. Now it's coming down again. I mean, there's still a lot of stress. And if you see the shares of First Republic Bank, for example, had declined by 60% today and things like that. So there is a still panic going on, OK?

And as a result of that, all these indicators of stress are very stressed out. [CHUCKLES] Remember credit spreads. I told you about that x that we had several lectures ago, the probability of default of a bond, the perceived possibility of default. All those things went up a lot. And the riskier the bonds, the closer you are to the financial system, particularly to small banks, the larger those spreads have become. So x went up a lot.

This picture that comes next, I find it very interesting from the point of view of this course. What this is is the following. This is the market expectation of the next hike by the Fed. The Fed next announcement on policy rate happens on the 22nd, March 22.

So remember what has been happening is that, since the US has been running sort of very hot, with lots of inflation, interest rates were increased very rapidly, at clips of 50 basis points, a clip that's very large changes in policy rates for a country as large as the US. And so we had this big 25 basis points increases. And a few meetings ago, they decided to lower the pace of the increases to 25 basis points, rather than 50 basis points per meeting. So they said, we're going to keep raising interest rates. But we're going to go out to 25 basis points.

Now, it turns out-- so this is 25 basis points. The data has become very hot. Remember we said inflation looked to have peaked and now is beginning sort of to turn around again, and it's beginning to rise.

So what has been happening is that the market says, OK, 25% basis points is the most likely next hike. But you see, the expectation of that is it was sort of steady around 30 basis points. Some people expected-- some major players expected the Fed to hike by 50 basis points, not 25 basis points.

By early last week, data came very hot. So there was indication that, clearly, inflation was picking up again. The labor market was very strong and so on. So look what happened to the bets. Immediately, as expected, value went up. This is all traded. It went up. And the expectation was, for the next meeting, was north of 40 basis points. So essentially, most of the market thought that the next hike would be 50 basis points, OK?

But look what happened. And then the problems with this bank began. And look how this plummeted. Today, it's 15 basis points expected value. That means very few people are expecting 50 basis points. A lot of people are thinking 25 still. But about an equal size is expecting 0-- so a pause in the interest rate hike by the Fed. And all that is a result of the events of the last two or three days. Yeah?

AUDIENCE: What is there to learn from this, I guess, in the bigger structure? Or who's at fault? Is it the people who got really scared-- all these depositors that got potentially scared or fear-mongering that capacity? Is it that the banks don't necessarily have-- I mean, I can't-- feel like it's an unrealistic--

RICARDO J. CABALLERO: There are many good questions, and you're going to see a lot of that. And politicians are going to talk a lot about that in the next few days and so on. It's very clear that there was some sort of regulatory failure here.

The regulator-- it was pretty obvious that-- I mean, this bank had doubled the asset size in a year. That's already a red flag. And these guys are regulated by the Fed. So the San Francisco Fed should have been worried about this bank.

There is issues, conventional issues of diversification. I mean it's pretty crazy to have all your savings in one bank, [CHUCKLES] especially if you're not insured. There is issues-- there is also-- remember, after the global financial crisis, there was a bill designed to-- legislation designed to strengthen the balance sheet of the banks. It made them hold a lot more capital. They are subject to-- if they're systemic, they are considered-- they are subject to stress tests, where regulators go in there and check whether portfolios can survive major macro shocks and so on.

And that's called the Dodd-Frank bill, OK? So that was done. In 2018, that got partially undone, and partially undone precisely for this type of banks. And these guys were actually lobbying for that. They said, OK, why don't you-- because to be sort of really stress-tested and so on by the regulators, you have to be big enough to really be able to leave a big mess.

And so what these guys and banks like them did is they lobby a lot. So they got the threshold of assets that you need to have in order to be stress-tested and so on raised dramatically. So they were right below the level that you need to be really sort of monitored very, very closely by the regulators, by the Fed. If you're a systemic bank, then the Fed regulates you.

These guys were lightly regulated by the Fed because they were below that threshold. So there are regulatory failures. It's clear that the regulator failed in what it did. Depositors didn't diversify enough. They didn't diversify enough, the bank itself, didn't diversify enough the source of funding.

I mean, what is very special with this bank-- and that's what gives us hope that this stuff is not going to spread all around-- is that their funding was very sort of-- was all coming from the same sector, large saver-- large depositors and so on. A typical bank doesn't have that. They have a much broader source of funding, which is what you need because otherwise-- so there are lots of lessons for bankers, for regulators, for macroeconomists as well.

I mean, to tell you the truth, one of the concerns with the pace at which the Fed has been hiking interest rates is that people were wondering, well, do we know whether something will break at some point? And there was lots of concern that something could break. Well, something broke now. And this broke entirely-- the part of the loss comes entirely from interest rate hikes.

Essentially, they got into a portfolio of long-- that was very long rates when rates began to rise. So they had losses entirely from that. And that's the risk. I mean, when you do monetary policy, is that some people will be stretched out there. And if you sometimes miss one that is important, that's very costly.

And I think that's one of the reasons they wanted to lower the interest rate hikes from 50 basis points to 25 basis points because they knew that something could be fragile out there. And this was one of those things. So those are lessons.

Now, I was about to connect with the things we did in a few lectures ago. I said, look, so this is telling you the markets, when they saw this x going up, it's sort of betting that the Fed will not hike interest rates as much and, in fact, that it may even pause. Rather than raise the interest rate as was planned, they may even pause interest rates.

We talked about this, lecture 7. Remember? In lecture 7, when we talk about the expanded IS-LM model, we had this x variable. And we said, look, if x goes up, that measure of riskiness and so on that increases the cost of borrowing for the private sector, that is like a shift in the IS to the left. For any given safe interest rate set by the central bank, now, all of a sudden, the cost of borrowing for companies is higher. And therefore, this is contractionary.

And then we went on, remember, we went on and said, well, here it is, the question, what should the central bank do in this case in which x went up? Yeah?

AUDIENCE: Lower interest rates.

RICARDO J. CABALLERO: That was the next slide, in fact, lower the interest rate because there's one component of cost of borrowing that's going up for firms, which is the x. Well, the Fed can offset that by lowering the interest rate. Now, here they're not planning yet to lower the interest rate. They were planning to raise interest rates, and now they're slowing down. That's the bet.

So the market knows some basic and expanded IS-LM model because that's what explains exactly what you should anticipate that's what is likely to happen. Anyways, that's where we are at this moment. Any questions about this? Otherwise, I'm going to move to the lecture, really. [CHUCKLES] But I thought we had to talk about it.

Well, anyways, if he gets a lot messier-- I'm hoping that it won't. But if it gets a lot messier, then we can add a section at the end. I can replace something for something on banking crisis and something like that, OK? Which is what I teach in one of my graduate courses. So it would be fun.

Anyway, so now what I want to do is start this IS-LM-PC model. And sort of the number-- the name is not very creative. It's pretty obvious what we're going to do here, no? [CHUCKLES] It's going to combine the IS-LM model with the Phillips curve.

And what this will do for us-- it will allow us to think not only about the impact of a policy or a shock, but also think about what happens over time with that shock, OK? Not to the long run, but we call this analysis sort of the short run, which is what happens in the very few early weeks, months, and what happens in the medium run-- say, a year, a year and a half from now. And so this model will allow us to put all of this together.

But so you don't get lost on this, so the analysis of the short run, essentially, will remain unchanged. It's our IS-LM model. It's just that, give it a little time, and you start seeing other certain effects get undone, and some others get exacerbated and so on, OK? But the short run is still IS-LM is your basic model. But then we're going to see that things happen over time.

So remember the IS-LM model was essentially this is equilibrium in the goods market, and then we had an LM which said i equal to i bar. And so I'm going to replace the LM already inside this, and I get my IS-LM model. So for any given i bar, I could solve out for equilibrium output.

Now, here, I'm going to I'm going to adopt the-- I didn't want to do it before, but I think at this point is useful because it will simplify the diagrams when we draw them to really think of the Fed as setting the real interest rate. So I'm going to assume now, and then I'm going to explain what happens when that's a bad assumption. But I'm going to assume for now that, rather than the Fed setting the nominal interest rate, that the Fed is setting the real interest rate, OK? So it's setting this. And then we're going to talk about problems.

I mean, in principle, if the interest rate is not against the 0 lower bound, the Fed can always do that. And say, OK, I'm going to give them-- I'm going to give you the nominal interest rate that, given this expected inflation, gives me the real interest rate I want, OK? That's what the Fed is really trying to do all the time. The Fed is not trying to figure out what is the equilibrium nominal interest rate. It's always trying to figure out whether the real interest rate is at the right level or not for the economy.

Now, the tool they have is a nominal interest rate. But they are thinking always about the real interest rate. And sometimes there is a problem because when you are against a 0 lower bound, then you can't affect the real interest rate in the same way. But most of the time you can.

And so I'm going to think-- I'm going to rewrite the IS-LM model now. But I'm going to call this r bar. And the bar is there just to tell you, remind you, that it's something that the Fed is setting, OK? So that's our IS-LM.

Remember the Phillips curve part. The Phillips-- that was our Phillips curve, remember? It's the last ones we replaced the natural rate of unemployment in there. We had an inflation minus expected inflation was a decreasing function of the unemployment gap.

So if unemployment was above the natural rate of unemployment, inflation was lower than expected inflation. And conversely, if the unemployment rate was lower, then the unemployment rate-- and the situation of the US today is that everything seems to point towards a situation where u is below u n. And that's the reason we're seeing sort of high inflation, OK?

Now, what I'm going to do next is I'm going to go from unemployment to output. So I can put-- you see, I don't have unemployment anywhere here. I have output. So what I want to do is play with the Phillips curve until I write it in the space of inflation and output, not inflation and unemployment so I can put the two curves together. That's what I want to do. Remember, I want to [CHUCKLES] merge here the IS-LM with the PC, so I want to put them in the same variable.

So remember, we have operated with a very simple production function in which output is equal to employment. Remember? That's what we assume. Employment, we call it n. Well, I can rewrite n, employment, as the labor force times 1 minus n, employment rate. That's employment, OK? So I can think of output as that.

Similarly, I can define what we call-- we don't call it natural output. We call it potential output, no? Potential output is defined as the output that you get when unemployment is at the natural rate of unemployment, OK? So that's our definition, three lines. The potential output is when the output you get, which in this-- with this production function, is the employment you get when you are at the unemployment-- at the natural rate of unemployment.

And now we can construct the difference, this minus that. This is something we call the output gap. And you may hear-- typically, when people talk about issues of monetary policy, often it's described in terms of this variable more than this gap. People talk about the output gap. If the output gap is positive, that means output is above the natural rate of the potential output. When the output gap is negative, that's output is below potential output.

So I can rewrite this. This minus that is just that. And now I can replace u minus u n here for minus Y minus Yn over L. And I get the Phillips curve now written in terms of the output gap and inflation. So this says when output is above potential output, when the output gap is positive, then inflation exceeds expected inflation. Conversely, when output is below potential output, then inflation is below expected inflation, OK?

But the logic is exactly the same as the logic we have here. Why is it that this happens? Well, because when output is above the potential output, that means, also, unemployment is lower than the natural rate of unemployment, OK? So that's the logic. Any question about this? No? OK, good.

So anyway, so now we have a Phillips curve and our IS-LM model. So let's put them together. And suppose for now-- and I'm going to-- that's the example I want to carry around is that expected inflation is equal to lagged inflation.

So this is a case in which expected inflation is not well anchored. And then we're going to talk about what happens when it's anchored and not anchored. So suppose that inflation is actually-- whatever is this year's inflation, that's what you expect for next year, OK?

So here I have an example in which here I'm plotting our IS-LM now, which I'm using remember the real interest rate here. And in this diagram down here, I'm plotting the Phillips curve. OK, so first thing, let's look about this Phillips curve. Why is it upward sloping? Here is output, so this is a parameter by n. And this is the left-hand-side variable. So it's obviously increasing in output.

Why is that? Well, because if output grows, that means unemployment goes down. That means wages go up, prices go up, and you get inflation. That's the mechanism, OK?

So in this particular example, we have-- this is the real interest rate that the Fed has set at this moment. That's the equilibrium output. What I'm trying to tell you here is that nothing has changed in the way you calculate equilibrium output. If you just use-- for that, you only need this top diagram in the short run.

I tell you what the real interest rate is set by the-- is, which is a decision by the Fed, then I know where my IS is. I can pin down output. I don't need this diagram to really pin down equilibrium output, OK? So nothing is different there. But-- and this is an example-- in this particular case, we have that inflation is rising here. And the question is, why?

So for this-- what I'm trying to say is that, for this IS, which is a function of fiscal policy, of how confident consumers are, and stuff like that, if the Fed chooses this real interest rate, we end up with this output. But it turns out that this level of output is increasing inflation. And the increase in inflation I can read here. I see the change in inflation is positive here. Why is this happening?

AUDIENCE: If you're changing the output that means you have a different level of employment, which changes the expected inflation, which will raise interest rates.

RICARDO J. CABALLERO: Yeah. Well, actually, here, I don't need to take-- this diagram would have also worked with expected inflation as a constant. Here, I'm more looking at what happens to inflation. I'm saying, if output is above the natural rate of output, then inflation is above expected inflation. But I can take expected inflation as a constant. In fact, here it is a constant because-- a constant in the sense that it's given at time t because it's a previous year's inflation.

But what is important is that you have too match aggregate demand. This economy is running very hot. [CHUCKLES] If output gap is positive, then that is going to lead to inflationary pressures. In this particular model, where expected inflation equal to lagged inflation, this is pretty bad because it's not only you get inflation above the target of the Fed, but inflation is rising over time.

So this is a case in which this central bank is setting the real interest rate too low, OK? You may want-- Japan is doing a little bit of this. But they have a reason, is that they have had inflation so low that it makes sense for them to build a little inflation. In the US, it made less sense.

The US got into trouble because it was in a situation like this for a long period of time. I mean, the reason we have today 6% inflation-- well, it depends which indicator you use-- is because the US experienced sort of a year with a situation like this, a year and a half. And that's what-- sometimes people say the Fed was behind the curve. They-- for a variety of reasons.

One, initially, potential output declined because of all the COVID-related issues. They expected that to recover quickly. So they said, let it go because I'm not going to start moving my policy rate around for something that will recover quickly as soon as COVID is gone. Well, it took longer to recover, and then it came sort of the Russian war shock and so on. And so natural rate of unemployment moved to the left to start.

And second, because of an enormous policy support, primarily, and the fact that houses were able to save a lot during COVID, there was a lot of pent-up demand. Then we had enormous aggregate demand when we came out of it. And the real interest rate that we had was just way too low for all that aggregate demand and that low potential output.

So we were in a situation like this. And inflation began to climb. Initially, expected inflation was very well anchored. And then we began to lose that anchor. Then we recovered, and now we're losing it again. We shall see what happens after this current episode.

But that was exactly the situation of the US and of most economies around the world. China is in a different story. But in most economies around the world, certainly Europe, all of them, the UK, continental Europe, and the UK, Latin America. Regardless of where you look, the situation was like that. Yes, real interest rates were way too low for the natural rate, the potential-- the level of the potential output we had at that time. And so we got into a situation like this.

OK, so that's the short run. In the short run, if you have an interest rate that is very low-- I mean, again, in the short run, you know how to determine output given a real interest rate. And then now you can say a little more and say, OK, but that's going to put inflation-- is going to cause inflationary pressures, up or down, depending on whether you are to the right or to the left of the natural rate of output. That's a new twist about the short run that you know.

But now let's start moving over time. So what happens over time? Well, first, let me define something. With potential output, we know what it is. But I'm going to define something which is called the natural rate of interest rate. Sometimes it's called the neutral interest rate. Sometimes it's called the Wicksellian interest rate. Let me not get into that story.

But I'm going to define implicitly the natural rate of interest rate, or the neutral rate of interest-- or some people call it r star. You may have heard of r star in the newspapers. People talk about r star. When they are talking about r star, they're talking about that, OK?

It's simply the interest rate that makes the potential output the equilibrium of the goods market, OK? So I'm solving implicitly. I say, I want to get as a result-- as an-- I want to get as a result of this equilibrium here the natural rate of output. What is the interest rate I need to pick so that's the case?

So I want to get the natural rate of output here, the potential output. I know that there is an interest rate, real interest rate, at which that holds. It's a matter of looking for the interest rate that does that. And in this particular diagram, it's this, you see? At this interest rate, the [INAUDIBLE] equilibrium output is exactly the natural rate of output.

So what I know is that, eventually, the economy will have to go there. Eventually, the economy will have to go there. So how will this happen in practice?

The way it will happen is, OK, this is the point we're at in the previous slide. So we're here. Well, that's building inflationary pressure. What do you think will happen? Inflation starts climbing.

Who will react? Who's in charge of not letting inflation get carried away? The central bank, the Fed. So what they start doing is hiking interest rates, which is exactly what they have been doing. And as they hike interest rate, they're going to keep-- they start increasing the real interest rate until they get to this point, OK? That's the idea.

So the point is that, in the medium run, the real interest-- real variables determine real variables, not monetary policy. Monetary policy has to follow whatever it is that the economy throws at them. Central banks have to follow whatever is the real interest rate. If they made a mistake, and they set a real interest rate which is not consistent with a stable inflation, they're going to learn about it.

And over time, they're going to have to fix that. And when will the problem go away? Only when they reach the natural rate of unemployment. And so that's what will happen. As the real interest rates start going up, from here to there, then you start seeing the change in inflation in this particular model, a declining and declining.

And when you get to a natural rate of output, at least you get a stable inflation. Is this adjustment clear? OK, good. OK, so this is what happened in the medium run. So the medium run is described as moving from that point here, the whole process of going back to a situation where we converge to a natural rate of interest rate and therefore the natural rate of output and the natural rate of unemployment and all these kind of things.

So that's-- the short run is whatever its output is. That's your IS-LM. The medium run is whatever the natural rate tells you should be the natural rate of unemployment, the natural rate of output, and therefore the natural rate of interest rate, the Wicksellian interest rate or the neutral interest rate, or r star. That's all pinned down there in the medium run. And the transition is obviously going from the short run, the pure IS-LM, to the natural rate type analysis.

Now, I assume here-- and that's related to your answer. I assume here that the expected inflation was an anchor-- that is, that expected inflation was equal to log inflation. That's-- I told you before that's not where central banks want to be, because that means that, if you mess up, inflation is high. Then, in order to bring it down, you also have to bring down expected inflation. You need to cause a recession.

And you can see that here. So suppose that the central bank starts with a level of inflation that it likes. Suppose that this is the model. So what I said before, the expected inflation is equal to lagged inflation. Suppose that the central bank starts at the level of inflation that it likes, 2% in the US, OK? But suppose that, for whatever reason, whatever shock, it finds itself with an interest rate that is too low, a real interest rate is too low.

That means inflation exceeds expected inflation, which was 2%. Well, by next year, say, suppose this gap is 2%. Well, by next year, the inflation is 4%. OK? So if inflation is 4%-- in fact, in the US it's got to be 9%. If you're at 9% level of inflation-- and this is the model of expected inflation you have-- then, Houston, you have a problem because it's not enough with raising interest rates up to this point.

Suppose that the Fed says, well, I don't like 9%. I'm going to go back to-- that clearly tells me that my output is way above the natural rate of output. I'm going to hike interest rate. And somebody tells the Fed, this is your natural interest rate. A very good research department tells them, look, this is your natural interest rate. Hike it to there.

Suppose the Fed hikes the interest rate to that point. What happens? So the Fed realized here this was going really wrong. They end up with 9% inflation. But somebody tells them, look, this is your natural-- your neutral interest rate, your r star. Bring it there. And the Fed immediately reacts and takes it there. What happens?

Is the Fed happy with the final outcome? And suppose the research department was really good, so they got it right. So the r star was the right r star, and the Fed implemented that policy, moving to-- suppose that the interest rate, the real interest rate they had, was minus 1%.

I'm telling you numbers that are not that different from what we had-- minus 1%. And the research department tells them, no, your rn is really 1%. So they hike interest rate by 2% immediately. And now what happens?

So I guess that question is a little vague. But I'm saying, is the central bank happy now that it-- ooh, I got-- we got the right natural rate, neutral rate? It's called neutral rate. Well, I'm telling you, I wouldn't be asking you if the Fed was happy after that.

So why do you think-- why are they unhappy? Why is the Fed unhappy after that? Not unhappy with the policy, but what I'm saying, the adjustment is not completed at that point. Why?

And I'm trying to make the bigger point for why central banks are so eager to maintain credibility and not have this kind of model of expected inflation. They want the markets to believe them that they have a target and that they want to go to that target and that, to set an expected inflation equal to that constant equal to the target, that's what they dream with because, if they don't get that, if they get this instead, things are nasty. And I'm trying to describe that nastiness-- I mean, what is happening now.

So what happens here? OK, so we went here. Inflation got to be 9%. And now the Fed, boom, hikes interest rate by 200 basis points. It got to a natural rate. We're back at output equal to natural rate of output. What is happening to inflation here?

So now we're back at the natural rate. What is happening to inflation? Well, this diagram tells you something very specific. It says it's not changing. So now your inflation, at least, is not changing. OK? So that's good. Yeah, at least it's not rising. Here it was rising. It's not changing.

But what is the problem? Inflation not changing when you're at 9% is not a good outcome for the Fed. The Fed wants 2%, not 9%. OK? So they-- when you have this modification, you need to do more than that because you need to bring expected inflation down. So you need to overshoot.

A Fed that finds itself with 9% inflation and has expected inflation an anchor needs to be inflation much lower. So it needs to raise interest in the short run much higher than the natural rate of interest rate. So it gets negative inflation here so you can bring the 9% back to 2%. No? So I have to generate the minus 7% here.

And to generate the minus 7% here, I need to bring output much below the natural rate of output. I need to cause a big recession to do that. And that's the reason the central banks don't want to be in this scenario, because with this level of inflation, if expected inflation becomes an anchor, then there is no way around that. The Fed will have to cause a big recession to get out of the inflationary problem.

Contrast that with a case in which the market-- the expected inflation is not equal to lagged inflation but is equal to whatever the Fed tells them is the long run average, 2%. So now, suppose that, therefore, rather than having here pi minus 1, I have that target, pi bar, which is 2%. So yeah, we got to 9%.

But for the Fed to go back to-- the Fed would say, oop, I messed up. Clearly, I set a real interest rate that was way too low, and so I end up with 9% inflation. But if credibility is maintained, and still people expect 2% in the medium run, then that means that the Fed doesn't need to cause a recession to bring inflation back to the normal level. It just needs to bring output to a level equal to potential output.

So it just needs to raise interest rate to rn, to the natural rate of the r star, not to r star plus something in order to have disinflation in the short run, OK? And we're there at this moment, on the verge of these two worlds. We have been alternating between the two worlds, still more biased towards the good world in which the Fed doesn't need to cause a-- they need-- the Fed needs to slow down the economy because it still needs to bring output down to Yn.

But that's a small change. In practice, all these things are growing over time. It just means that the economy grows at a lower pace for a few quarters, OK? But it's very different to have to bring temporary output down here because, for that, you need to sort of bring the-- growth has to become negative for some period of time in order to bring inflation down. Good.

So big lessons from this part are that, as I said before, in the medium run-- so I haven't changed-- I haven't changed any of the two models. I told you what was the model of the short run, the IS-LM. That's still true here.

I told you then what was the model of the natural rate of unemployment and all that and that there we didn't have any monetary policy or anything like that. We look at what happened in the labor market, and we determine the natural rate of unemployment. And that was it, OK?

So the medium run here is when we are in that world in which it has nothing to do with monetary policy. It has all to do with real variables, OK? What is an equilibrium, long-run real interest rate, what is a natural rate of unemployment, and things of that kind.

But monetary policy, what it does do is certainly determine, in the short run, equilibrium output. But in the medium run, it determines what is a nominal interest rate, equilibrium nominal interest rate, and the level of inflation because the economy will have a real interest rate, which is the r star and rn. The economy has rn.

But the Fed-- and the Fed will not get to pick what rn is. The only thing that the Fed will get to pick in the medium run is what is a nominal interest rate that is consistent with that rn, because suppose that the rn is, say, 2%. If the economy ends up having 3% inflation on average, that means that the nominal interest rate for the long run is going to have to be 5%.

If instead, that economy has 2% inflation average, then that means that the long-run nominal interest rate will be 4%. So monetary policy affects the nominal interest rate, nominal variables in the medium run, but not the real variables. The real variables are determined by the real sector.

And that's often referred as the neutrality of money. In the medium run and the long run, money tends to be neutral. And that's what it means, is that real variables are determined by something entirely different.

But in the short run, monetary policy is the main game in town. And in the medium run, it's just about inflation. It's not about real activity. Let me stop here.