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Arvind Krishnamurthy on QE: What Have We Learned?

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Webinar Transcript

Transcript:

Markus Brunnermeier: So welcome back everybody to another webinar organized by Princeton for everyone worldwide, we're very happy to have Arvind Krishnamurthy with us, hi Arvind.

Arvind Krishnamurthy: Hey Markus, thanks for having me on.

Markus Brunnermeier: It is great to have you.

Markus Brunnermeier: Arvind will talk about quantitative easing, what have we learned so far, so we're looking forward to this talk. Before we go to Arvind, let me just give a few opening remarks, and then you learn from Arvind more about QE and perhaps also a little bit about QT, quantitative tightening. So, if you look at monetary policy, the different channels that you can work on, it can affect consumption demand. You manage aggregate consumption or redistribute wealth by moving wealth from low marginal benefit consumer households to high marginal benefit consumer households. Or it can also affect the portfolio choice, and you know this way you affect risk premia, you also redistribute but you give it to people who might be less risk averse or have a higher productivity and this way you affect the outcome of the economy as well. QE programs are mostly– all about asset purchases and you can buy government bonds and a particular way to buy government bonds is like yield curve management. You affected the term premia. And of course there's interaction between the Central Bank and the debt management office, or the Treasury. Or, you can also buy mortgages and corporate bonds, you also have an effect on the risk premia. Another form of unconventional monetary policies to have negative interest rates, you hit the zero lower bound or the effective lower bound, the reversal rate, at some point, and then you can’t go further into negative territory. Now, if you talk about quantitative easing and asset purchases, the Central Bank essentially swaps a fixed interest rate government bond for floating reserves, by floating I mean the interest rate is floating, depends on the policy rate, whatever interest to get on the reserves is moving around based on the policy in it, and the question is, if the Central Bank is actually you know buying these long term bonds takes it out and at the same time, the traditional discuss going the opposite direction, so is it like a treasury shortening the debt maturity, or is the simpler wash around the one hand, to take out long dangerous and place it was floating the serves would have been the same if the Treasury or the Finance Minister or a debt management offices just offering shorter debt maturity for its government bonds and if it's a wash, it might not play anything. Can we conclude really QE really works only if it involves risky assets like corporate bonds or mortgage backed securities and other things? Or is it driven by a political game

between the Central Bank and the Treasury so essentially the argument is the following: the central bank hikes the maturities after QE. And if it hikes interest rates after having bought a lot of long term bonds, the Central Bank will suffer some capital losses, so there will be capital losses from the Central Bank because it has bought these long term bonds and then the interest rate goes up, the long term bonds lose in value. And the question is how long can the Central Bank sustain losses that depends very much on whether the Treasury is actually recapitalizing the Central Bank. And if this is difficult, then it's very costly for the Central Bank to hike interest rates, later on, hence, ex-ante it signals that the interest rate will stay lower for longer, and this way it has some signaling effect to it, it would also the signaling channel this particular one outlined here, and Arvind will talk to many more of the signaling channels. This particularly means an undercapitalized Central Bank, which has bad relationships with the Finance Ministry, is more powerful in signaling that it will stay at a low interest rate environment for much longer.

4:03
Markus Brunnermeier: So the other thing I would like to know is how does QE change the effectiveness of interest rate policy subsequently, and what's the optimal sequencing within QE and interest rate policy? So as I said, QE is a swap of bonds for reserves, and you can think of it as a bond, as a safe asset, whichever they can hold. But with a fixed interest rate, while the reserves have a floating interest rate, but only the banks can hold, and you have to pick that on a balance sheet of a bank, we have to have some of the reserves and also have some common bonds and other loans, with the real economy, and then they have deposits. And, of course, what happens, but when you change the interest rate or the policy rate, you change the relative value of these reserves relative to the bonds, because the interest rate on the bonds will stay high, reserves– you cut interest rates, interest is going down and typically the deposit interest will go down as well, at the same time. So typically what you do is when you cut interest rates, the bond value goes up and this actually recapitalizes the banks so, there are benefits, because if you finance it because it's cheaper for the banks, so the equity of the net worth of the banks is expanding. There's what Yuriy and I called stealth recapitalisations, so interested moves also recapitalize the banks and that's one way to stabilize the economy. So, in particular, if the banks or any other sectors in the economy you've targeted are in financial difficulties, you can actually stabilize the situation. And QE, as I said, the central bank signals that the rates will stay low for long, so the reevaluation effects will be much more dramatic. But there's also a second effect which I would like to highlight after QE, the banks will have fewer bonds and they will have more reserves, Aad that means the effect subsequently will be less redistributive because they're just not so many bonds out there, so the revelation effects will be smaller. And then, this is a question or issue that if you do QE and then the subsequent interest rate cut will be less effective, hence the optimal sequencing is first to cut interest rates, all the way down, and then only then the QE. And if we go for quantitative tightening you want to go the opposite direction: first of the quantity tightening and then you only hike the interest rates, because essentially if you do qualitative tightening, if you do it the other way around, the interest rate hike will be less effective. So first put the long term bonds into the economy and then hike the interest rates. So that's about the optimal sequencing from this particular angle. But, more broadly, the question is, if you have this redistributive monetary policy perspective that you shift wealth around either through demand management, because you want to stimulate certain consumption, shifted to high propensity consumers, or you want to shift it to certain sectors, which you know our balance sheet impaired, the question is where's the bottleneck? And where do you want to shift it to? And you could argue that in a global financial crisis and after 2008 after Lehman, the Household sector was primarily financially impaired, whereas in the Covid crisis, the corporate sector was more impacted. Or in Japan in the 1990s, the corporate sector was much more impacted; the financial sector is typically always involved as well. But if you want to shift wealth to the household sector, QE should involve primarily mortgage backed securities, because you

boost up the house prices and this helps the household sector. If the corporate sectors are financially impaired, you want to buy more corporate bonds, because we help the corporate sector to refinance itself much more cheaply.

8:03
So with all of this, you want to look as worse, the bottleneck in which sectors in the economy is balance sheet impaired and then help this particular sector. And then, by doing so, of course, you change the price of risk or the risk premia, whole thing, and by helping this impaired sector, you have the whole economy and it's actually can be a pareto improvement, with any redistribution from one sector away the economy will get stimulated so everybody can be better off. So it's not that strict redistribution, in that sense. That it takes something away and gives it to somebody else, who will end up hurting the first group because they also benefit from the economy doing better. So, with this, let me go to Arvind's poll questions which you answered before and so, how much role did QE play in driving the asset price boom we have in the last decade, a little to none moderately or it was a central factor? And the audience answered 6%, 47%, and 47% so it's moderate or quite a lot, it was a central factor of driving asset prices up so more than interest rate moves it was more the QE to some extent. And the second question was how much was the role of QE to support recovery of the economy after 2008, and again little to none, moderate, or the central factor, the answers were 11%, 53%, and 36%, so really important fact done so, everybody of attributes quite a bit to QE. And then the third question was what are the areas of QE research that we should do, which with most understanding we need. And they actually, you know, should work mostly on asset pricing and QE, or the impact of theory on banking and firms or QE, and monetary aspects, and when should we also build a macro model which indicates QE, and that makes an important element to it. And the answers are pretty evenly split so it's 24%, 19%, 23%, and 35%, so then D gets a little bit more, macro modeling with it to integrate QE. But otherwise it's pretty evenly split, so let's see whether we change our minds if we listen to Arvind and he will tell us what a big holes in our research agendas. Thanks a lot Arvind, looking forward to your presentation.

Arvind Krishnamurthy: Okay, thanks Markus I'm just going to share my screen. Okay. So thank you once again Markus for having me here on this great seminar series, and thank you to the audience for listening to what I have to say about this topic. And you know, in a way, as the poll questions show, there are still lots of open questions around QE. I know, and we have sort of a gut feeling that it's had an important effect on asset prices and has an important effect on economic growth over the last decade, but we don't really understand exactly how. And, in a sense, the answer to the last question tells us that all the little pieces that we think might be relevant for how QE impacts the world, we are still unsure which pieces matter the most and which pieces matter the least. So what I'm going to try to do in this talk is take stock of what, at least I have learned about research over the last 15 years on QE. The slides, by the way, that I'm going to walk you through are posted to my website and there are references to some papers that people can look at. And then I can, as I go through this, maybe I'll try to give you my own view on where I think the research is strongest and where the researchers in my mind weakest. So just to step back, you know what would researchers/policymakers really like to understand about QE? I'd say in a sense, you'd like the narrow question, which is what is the impact of a given size of purchase. You know $1 of say mortgage purchases, you know, in a given asset market, say the mortgage market, in a given economic state. You know, in a boom or a recession, a financial crisis; what's the impact of that on the macro economy. That's sort of the answer we would want, and there's a collection of conditionalities there that we'd like to have an answer to. And then, when we say macro, there are a broad set of questions here, impacts on output, distributional consequences, international spillovers inflation, financial stability, fiscal effects, some of the stuff Markus put up on his slides and then there's this other

very important question which is QE is a particular policy tool and how does this particular policy to compare to the standard policy tool that central banks have, which is to set the short rate and then indicate where the path of the policy, the short grade is going to go over the next couple of years.

13:19
Arvind Krishnamurthy: These are the questions which we would like to have answers to, and this is, these are questions that research has given thought over the last decade, so what I'm going to do in this talk is run through research findings fairly selectively. And, as I said, talk to you about what I think we know more about and what we know less about and then talk a little bit about where the research goes from here. That talk is going to start with asset pricing, which I'd say most of the early work on QE was really asset pricing events studies so I'll start by talking about that. I actually think we've learned quite a lot from the asset pricing event studies and it's the most, in my mind, solid evidence for how it works. And then I want to talk you through transmission in two banks at firms and then come back and talk about macro. Okay, so let me start here, this is a picture from a paper I have with Vissing-Jorgensen looking at one of the early QE announcements of the Fed. This March 18, 2009 announcement for the Fed indicated a big expansion and purchases of treasuries and mortgages. The announcement is made, you can see here at 2:15, treasury yields drop by on the order of 40-50 basis points. There's a big increase in trading volume. It's very tightly connected to the announcement and it's very salient, both yields fall, as well as trading volume rise, indicating that there's a QE effect that's very present to them. So the asset pricing work around QE is built around this type of study and events study around a QE announcement, event windows are very tight, so you know, usually the issue when you look at the impact of policy on the economy is you have an identification challenge, which is perhaps it's what's happening in the economy that's causing the policy reaction, but with a lot of the QE events studies, the event windows are very tight so it's very clear it's QE related, rather than anything about omitted variable or reverse causality. The identification challenges then are different and then QE it's really about the channels through which QE ends up affecting yields. So treasury yields fell 40 basis points in that announcement. Why have they fallen 40 basis points? I'm just going to lay out a couple of different ways of thinking about why interest rates fell by so much on that event. One is what I'm going to think about as conventional broad challenges so if QE is coupled with signals about the path of the policy rate, QE is an easing move by the Central Bank, and if that signals also further easing through conventional mechanisms through the path of the policy rate, then you would expect that interest rates would fall for conventional reasons upon a QE announcement. That interest rate fall by expectations hypotheses should be expected to affect short, medium and long term rates. That's a signal of the path of the policy rate; QE could also signal something about policymaker preferences, you know if you're thinking about the path of the policy read through a filter about what is the central bank's Taylor rule coefficients, and you're not sure about the central bank's general coefficients, then a QE action will make investors update what they think about policymaker preferences and that, too, will have an impact on expectations about the path of the policy rate. I still say this is a conventional broad channel, because if you think that the Fed that does QE is also going to be easy with respect to the short rate, that is an interest rate effect that is within the class of moving short rates, as it would be via forward guidance. And then the other thing that I'd say is the conventional effect that also comes up whenever you think about conventional monetary policy signaling news about the economy.

17:48

If the Fed is doing something, because it's responding to good news and bad news itself is information about the economy, which should be expected to affect asset markets. So, in contrast to conventional broad channels, another possible way in which QE can work is through narrow channels. So, for example, this is a channel that has received a lot of attention. If, for example, risk premia on mortgages are particularly high and the Fed goes out and buys mortgages, then maybe a channel through which the Fed may be affecting mortgage rates is by removing mortgage risk out of the market. Then, reducing the risk price on mortgage risk and so as a result, reducing mortgage rates. Similarly, if the Fed takes out a lot of long duration assets by buying a lot of long treasuries or long mortgages, then the net amount of duration held in the private sector falls, and you might expect that duration risk premia would fall. This is an effect that is running through risk premia, very tied to buying and selling assets, particularly risky assets; it's not about the path of the policy. Right, so there are these different things that can be happening with QE and almost surely, all of these things are happening so when we evaluate QE and try to understand how QE is working, we need to be able to sort out which of these things are happening. And there's two aspects of that, one of those is the research aspect, the research aspect is simply just to understand how this mechanism is impacting the economy, we need to sort of parse out how much of each of these things is at play to understand mechanisms at work. There's also a policymaker reason to understand this. For example, if you think QE is working by signaling the boss of the path of the policy rate, then a conclusion you might yield is let's not do QE, let's try to strengthen our communication, say via forward guidance about the path of the policy rate. If QE is working by helping the Fed communicate better about the path of the policy rate, then you don't need QE, you can just communicate better. So if you thought it's working through conventional channels, then there are perhaps alternative ways to also run QE. In contrast, if you thought that he was working particularly importantly through these unconventional narrow channels, then you might conclude that QE particularly matters when risk premia are high. Right if what's happening is the Fed goes out and buys mortgages and that reduces mortgage risk premia, then that tells you that the impact of QE will depend upon the current state of risk premia. So sorting this stuff out is important both from a policy perspective as well as from a research perspective.

Markus Brunnermeier: Arvind can I ask you a quick question? One is that the first, the broad channels and core, essentially, why is then QE better than forward guidance, or why do you mean– you will go into that I guess.

Arvind Krishnamurthy: I'm not going to go into that Markus, but I'd say, that is, to me, a policy question that needs to be sorted out, so if research can tell us how QE is working and for example suppose research, told us that QE was primarily working most of the time this way, then you would say QE is substitutable for forward guidance. If, instead, I told you, QE works through here but also works here, and maybe I told you, it worked particularly well through here, and I will say this as I go through, particularly well through here during times of financial distress, that tells you that those two policies are not substitutable.

21:31
Markus Brunnermeier: The other question Eugene Kandel was asking is you know if it's a signaling channel about the economy, are you sure the causality goes in this one direction so it could, he argues that the Fed knows more about the economy, as you propose, but it could also be that QE is essentially driven by the information or is it the other way around this is, of course, so the causality: is it clear the way it goes?

Arvind Krishnamurthy: I mean you can run it in either direction, either the Fed's signaling news about the economy because it knows something when it takes the action or the Fed is responding to news about the economy. If you're saying the Fed's responding to news about the economy, then you have to– then it comes back to this. I think the nice thing about this type of event window is it is not news about the economy that evolved in those three minutes at which the policy announcement happened so it's very unlikely that the Fed is responding to a three minute policy news and then went out and did QE; that strikes me as unlikely. What's likely here is the Fed's doing something and the markets moving rates, either the markets moving rates, because of the action the Fed's doing or because of information the Fed's conveying by taking its action.

Markus Brunnermeier: And if you extend this window, it's a permanent effect, it's not just for one or two days and then comes back.

Arvind Krishnamurthy: Yeah I mean you know as you go longer with these event windows, your power starts to fall, so it's the sort of main usual type of– for those who have done finance event study, you know that narrow event window gives you lots of power, which you lose as you go further out. So I think the answer is, we don't know but I should state that this event in particular, for example, the one that Matt and I study here, is an announcement, it's not the actual purchase. So purchases are often coming six months later than these announcements. So these are not microstructure effects of the Fed going out and buying treasuries, these are the Fed saying I'm going to be buying treasuries in six months.

Markus Brunnermeier: Have you also looked at events where the Feds says we will stop our QE?

Arvind Krishnamurthy: Yes, there's interesting events in which– I mean the most famous event is the taper tantrum in 2013. The Fed gave signals that they were likely to curtail their QE and then you see the reverse of this type of effect right. So, then you can also ask the same question about that reversal, is it reversing because of the market thinking, the Fed stopping doing QE and therefore it's going to raise short term rates or is it because of the fact that the Fed's not going to be buying so much, or maybe selling, and that sales is going to have a big impact on on asset prices.

24:28
The same issue Markus we can talk about this later, but it will pop up when we talk about QT. But you know, in a sense, these sets of issues are present with QE and you can't avoid them, you have to sort of figure out how to parse them out and separate things and things, which channels are operating when.

Markus Brunnermeier: We will also talk about whether you want to surprise the market or not. With QT, we don't want to surprise. Removing QE, you don't want to surprise the market, but with QE, starting it, you might want to have a surprise. Can you say something about that?

Arvind Krishnamurthy: I don't have anything to say about surprise versus no surprise. Yeah I mean…

Markus Brunnermeier: The one big lesson of the taper tantrum was we really now prepare the market with speech and all this to avoid a taper tantrum.

Arvind Krishnamurthy: Yeah I don't think anything about QE research particularly tells us about surprise versus not surprise. It's clear that even when you think about conventional monetary policy, the Central Bank goes to great pains to lay out their plans, and maybe one way of thinking about that is to maybe reduce uncertainty about stuff. I mean let's say John Taylor would be a big proponent of rules for that reason, so I don't think I have anything to say, particularly about QE with respect to that.

Markus Brunnermeier: One could argue that your estimates are an underestimate of the effect.

Arvind Krishnamurthy: Oh yes, absolutely I mean and if you go back to the first question I raised, which would really like for knowledge, I buy $1 of some asset in a given state. How much impact does it have on the macro economy? And the problem with the events studies is that the market has an expectation that the Fed is going to buy something and the Fed says it's going to buy something different, and so it's in response to the delta of what the Fed's expected to buy, which is surely an underestimate of the full effect. What the event studies help us do is given an event of some changes, some delta and what the Fed's going to buy, you can see all of these potential channels at play, and so you can difference out things as you look within the event and that's not a function of the size of the shock, because all of these channels will just scale up with the size of the shock. I want to say just a little bit more about narrow channels and then I'll show you some more data. I'm doing these two narrow channels, particularly because I'm going to talk a little bit about the paper that thinks about these narrow channels, so you know a lot of QE has been focused on changing the supply of safe assets so buying and selling treasuries, buying and selling bunds and gilts. We know, and, for example, this is some other work I've done with Annette that investors have mandates for special demands for safe bonds, so that if you were to change the supply of safe bonds, you're going to be moving along the investors' demand curve for safe bonds and that will impact you.

27:41
So that's a narrow channel, that's a specific narrow channel that you might expect to play out when you're changing the supply of safe assets. I could say the same thing in the context of mortgage backed securities, there's investors who have specific mandates to buy mortgages, if you change the supply of mortgages, you will change the supply of what's available to buy, which will trace along the demand curve. There's another way of thinking about narrow channels, which is also present and may be happening simultaneously, which is a risk premium and I mentioned this before, if there's an investor SDF that says a function of the quantity of risk held by the investor, then changing the quantity of risk by the Fed, say, pulling risky assets out of the economy will just change the risk price, and then sure to be expected to change the risk price across a bunch of assets. This is also a way to think about QE and an answer that this way of thinking about QE gives, which is particularly pertinent, is how narrow? And what I mean by that is, if you buy mortgages, you're changing mortgage risk. Maybe that changes mortgage yields. What else does it change? And to answer that question the the theory question is what else does this SDF price and then the empirical question is, what are the spillovers that I see when I buy some assets. So I'm going to say a bit more about each of these things as I continue to go through. Right, let me walk you through, I think, a very nice event study. This is from a team at the Bank of England, looking at the U.K.'s Gilt purchases. In 2009, the Bank of England said that they were going to buy long dated gilts. Okay, the black line here are changes in yields around this announcement by maturity. And when you look at just the black line, this actually looks a lot like a conventional monetary policy shock, so conventionally you know if the Central Bank was to say they're going to lower short rates you'll see a big reaction in the near term, smaller reaction in middle maturities, and an even smaller reaction in longer term. So you're just

looking at this you'd say this is not about QE, this is mostly about the conventional channel through which the Central Bank is impacting short term rates, and medium and long term rates. You get a little bit more of a sense that something else is going on, when you compare the gilt yields to the OIS yields, so the gray line here is the change in the yield or the OIS spread. And that spread move is smaller than the black line. If you think, for example, that– so one hypothesis, when you look at that first thing is all the OIS curve is moving, say, for conventional monetary policy reasons, and if that was the case, then the additional part is the part that's due to the effect of the central bank's gilt purchases right. So that's a better floating around kind of left hand panel.

Markus Brunnermeier: So, Arvind can you explain OIS?

Arvind Krishnamurthy: OIS: a swap curve. This one is interesting because the Bank of England is buying gilts, but it's not as if they're buying swaps. Interest rate swaps are being traded in the market between players, they're buying gilts, you can see guilt deals fall. A conventional channel would impact both gilts, as well as swaps, in a sense, equally. The fact that the yield OIS spread moves about half of what the gilt moves tells us it's not moving equally, so it's not just a conventional channel, there's an additional effect that must be due to the QE purchases of moving gilts.

31:38
Arvind Krishnamurthy: So that shows up to some extent here, the March 4th announcement is really, in a way cooler, for identification, and I'll tell you what I mean by cooler. So on March 5th, the Bank of England announced their purchases are actually in a tight range between five and 25 years. The early announcement was we're just going to buy long dated gilts. Then the Bank of England comes out and says no, no we're going to buy stuff in the five to 25 year range. And now you see a pattern that doesn't look like conventional policy. This looks very much like QE policy and why do I say that? Look at the black line, our gilt yields falling in the five to 25 year maturity, particularly. It doesn't look like the conventional policy reaction of a curve change that looks like this. Moreover, a second thing that you see here is the change in gilts is very closely matched to the changing yield OIS spread, which is to tell you that the bulk of the move in the gilt curve is a moving the guilt curve, the OIS curve moves much less. So when you look at this, this particular picture tells you that there's a big component of QE, that is when the Central Bank buys gilts, gilts move a lot, not for conventional reasons but gilts move a lot. The OIS curve also moves, but much less. Maybe, if you look at these two pictures you'd say gilts move, say, 100 basis points and the OIS moves about 20 basis points so there's some spillover but there's mostly about the specific assets. Right and that's what I mean by a narrow channel.

Markus Brunnermeier: Just to give you an example, the example would be that the gilts I can use as a good collateral while the OIS swaps, I cannot?

Arvind Krishnamurthy: That's one way of thinking about it, in a way that's I think that's the research question, what is it, why is it that the Central Bank by buying gilts is moving gilts a lot but isn’t necessarily moving the OIS curve. And so two ways of thinking about this are gilts are special assets that are good collateral, that are in high demand by pension funds, say, in the UK, looking to defuse future obligations, and so, if you suck up some gilts, you're going to make gilts more expensive, and that's why these yields fall. Swaps are not the same thing. And then why are swaps moving well? Maybe the answer is both gilts and swaps are long duration assets and there's an SDF that's pricing both of them. And so, then the spillover here is a component

that's due to collateral and a smaller component that's due to the SDF pricing, both as being interest rate risk prevalent.

Markus Brunnermeier: So what's striking about this figure is also that there's some change between the 14 year maturity and the 15 year maturity, there's a jump even in the OIS and the gilt. Do you have an explanation for that?

Arvind Krishnamurthy: I don't.

Markus Brunnermeier: Both in February and March.

Arvind Krishnamurthy: I don't have an explanation for that. We can ask them, you should have them on and ask them about these curves, I'm guessing it's particulars of the gilt market in this maturity spectrum. I mean, I think I know more about the Treasury market, it might be that in the treasure market the 10 year bond is very actively traded, and then stuff between roughly 10 and 30 is not that actively traded, so there's always going to be some sort of market specific liquidity effects that might be playing. So maybe something like that is at work here, I don't know.

35:14
Markus Brunnermeier: Do you think it's also more liquid?

Arvind Krishnamurthy: And why is the OIS matching that? Yeah I don't have a good answer. We could also say, and this is the event study so there's always sort of noise with these types of things so I'm not sure how much I want to ascribe to particular differences in data here. Here's another really nice announcement, where you can see the same types of effects playing out. This is from D'Amico and a team at the Fed who look at an event around the Fed's news regarding reinvestment of their asset portfolio. This is August 10, 2010 and the Fed's reinvesting their existing asset portfolio and at 2:15 the Fed news is we're going to reinvest in long term bonds. And so here are our prices of nine and a half year bonds, 10 year bonds, and 14 year bonds; all of these one prices move up upon this news. The market inferring the Fed's going to be buying long term bonds. Then at 2:45 here the Fed says actually, no, we're only going to be buying bonds under 10 years, and you can see here the nine year bond price remains high, but the other ones come down. So when you look at these last two things, one of the things that really jumps out at you, is what the Fed buys, or what a central bank buys has the biggest impact. It's not as if the other stuff doesn't have an impact, but it's much smaller than the impact of the purchases and you see that here, you see that, on the previous graphs. That's very strong support for the existence of a fairly sizable narrow channel for the way in which purchases work up.

Markus Brunnermeier: So Arvind, can I ask a different question? Are there natural events where the U.S. Treasury decides, you know, to issue something of a different maturity, which would not have communication channels or the standard conventional channel.

Arvind Krishnamurthy: That's a great question so you know, one of the difficulties with sorting through QE work and figuring out the mechanisms by which QE is impacting asset prices because the Central Bank going up buying stuff has all sorts of other implications for the world. For example, I haven't even talked about this, but when the Fed by QE, they're also buying treasuries, they're also injecting reserves into the system, so there's a collection of other things at work, and parsing through– what you'd really like is a narrow particular channel at play, which Markus, as you point out, sometimes happens with a change in fiscal policy regarding maturity

structures. So there's a famous old example of when the U.S. Treasury stopped issuing 30 year treasury bonds, this was a surprise announcement, I think it was like 2001, and you saw distinctly the long end of the Treasury curve yields falling a bunch, because it was clear that there was less 30 year treasury bonds coming out in the future. So there are events like that. I know of some other events along those lines which look like narrow channel events along these lines. So, in that sense, the two data points I'm just showing you are actually consistent with other stuff that looks like demand and supply factors that play out. But I think I also wanted to make the point and maybe here it's very clear, this is a very significant portion of some of the QE events. There's also potentially signaling effects through conventional, but there's also importantly narrow channel effects here that are playing out through the specific asset that's being bought.

39:11
Arvind Krishnamurthy: There's a bunch more papers that I think come to similar conclusions looking at different types of asset purchases and I'll just mention a bit of this, and for those of you who are interested, you can click on these links on the slides. I have some papers, with Annette looking at mortgage backed purchases, which come to the conclusion that MBS purchases moved MBS yields the most, it moved other stuff but moved the MBS yields that the Fed was buying the most. There's some work in Europe on the EC'sB announcements on their security market purchase program where it looks like the target countries sovereign yields move the most particularly during stress periods. So, for example, there's lots of evidence that the ECB's sovereign bond purchases particularly compress spreads. There's other evidence, also from Europe that looks at the CSPP, which is the corporate bond purchase program where it looks really like the purchase programs lowered eligible corporate bond yields a lot, didn't move neighboring bond yields as much or other asset classes as much so again very generic targeted and I'll talk about this one, a couple of times, there's a nice paper by Haddad, Muir, and Moreira looking at interventions during the Fed's Covid QE in which it looked like the investment grade corporate bond announcements really moved IG yields a lot and there's other results like that around municipal as well as corporate bonds. What I've just walked you through is asset pricing evidence, so if I step back, what does the asset pricing evidence tell me? It tells me that there are some conventional broad channels and there are some specific narrow channels, where the asset being bought is the thing that's moving the most. Now let's look at quantities, and if I take from the asset pricing evidence that what's being bought moves the most, then a second effect you might get is that originations should move, particularly with what's being bought. This is a paper by DiMaggio, Kermani and Palmer, a research paper which looks at originations of mortgages by different QE programs, it goes down the following road, which is the Fed particularly bought conforming mortgages not jumbo mortgages. If you think the mechanism is that the Fed bought conforming mortgages and moved up the price of conforming mortgages a lot, what you should expect to see is banks originating a lot more conforming mortgages. So you can use the jumbos as a control and ask is that what happened? That is roughly what happens here, you can see, the signs of these jumbos are all negative, which is to say that most of the action or mortgage origination is happening in the conforming space, rather than the jumbo space, so that's a way of showing that the quantities that are responding are the quantities of what the central bank is purchasing.

Markus Brunnermeier: Can I ask another question? Of course the Fed typically tries to buy newly issued mortgage backed securities, not legacy issues, will you go into that?

Arvind Krishnamurthy: I'm not going to go into that, I have a paper with Annette for 2013 Jackson Hole, a paper which spends a considerable amount of time on that. You see, in a way,

exactly that, and I think actually it made a lot of sense for the Fed to do that. If you take the perspective that what you're buying is what moves the most in yield, and that will is what will trigger more issuance and your objective was say to support the housing market then you should be buying new issue mortgages. That's the most direct way in which to impact stuff, and that is what the Fed was buying. The Fed was buying conforming new issue mortgages; everything here is new issue mortgage loans. And then also in a sense those two things match up well.

43:26
Markus Brunnermeier: Would you include house prices also in the asset pricing category or that's already in the macro channels.

Arvind Krishnamurthy: No, I think one would have to, but I don't know how to do it. And Markus it's a way– the poll question– I think that the difficulty is that we have fairly good evidence and, hopefully, you have now a sense of this there's a lot more evidence, by the way along these lines, which is around how QE affects particular assets, and particular asset markets at particular times. I think zooming out and trying to ascribe a big portion of the boom from over the last decade in asset values and home prices due to QE is considerably harder. I think, to do that we need to take this evidence, integrate it into some type of bigger macro model, and then see whether we can make sense of what happened more broadly.

Markus Brunnermeier: Can I just inject another thought. One way is to buy just this particular asset in order to push up this particular asset, because there are narrowly defined, and they are essentially segmented markets. An alternative way would also be to make sure that markets are less segmented so you essentially help players who desegment markets or combine markets and recapitalize them and this way we will be more widespread rather than only affecting this particular asset class.

Arvind Krishnamurthy: Okay, so hold that thought. I think I have some more to say about them. Let me just show you one more bit of QE evidence and partly I'm showing this to you because it confirms what I've shown you before also because I think this is my interesting research and we've learned about QE in part from asset prices, I think we've also learned about QE in part from looking at at quantities and bank loan origination, that gives us also a window into the way in which QE works. So this is a paper by Rodnyansky and Darmouni, and they look at the following question, which is the Fed bought mortgages, as well as treasuries. If you look at the cross section of banks, there's different banks and banks are differently involved in the mortgage business, some banks are more in the mortgage business and some banks are less. If you think it's a narrow channel, then it should be that mortgage purchases should be the thing that drives lending and in the data when the Fed runs its QE programs, QE1 and QE3 are particularly connected to mortgages, QE2 is a treasury purchase program. You see, lending in the cross section by mortgage type banks, respond more in QE1 and QE3, really very little response in QE2, the Treasury purchase program and the type of lending that these banks are doing is real estate lending. And so that makes a lot of sense, one of the other things that comes out of this study is that C and I lending in the mortgage purchase program doesn't move so the Fed's mortgage purchase program looks like it spills over to real estate lending, but less to C and I lending and I don't know the answer to why this is happening, but it's an important data point because it informs us on how to think about how banks are making loan portfolios, in response to what's happening in terms of asset prices.

47:02

Arvind Krishnamurthy: Okay, so I'm going to talk you through another study, which I think is also very interesting, because it indicates how the impact of QE depends upon market conditions, so this is from a very nice paper by Haddad, Muir, and Moreira looking at the Fed's Covid intervention, so QE interventions during the Covid crisis. And this is what they're graphing, here is the yields on Google's corporate bonds. So Google's corporate bonds move up around the Covid crisis on the order of 150 basis points. Google's CDS really doesn't move. So this is corporate bond yields on a fairly high investment grade firm, highly rated, a very good investment group for moving up a bunch. The Fed goes out on March 23 and announces that they're going to roll out a program that will be buying corporate bonds. Yields come way back down, that is a very strong effect. It's both a narrow channel effect, in the sense that the Fed was stepping in with investment grade issues in line and it's an effect that's very sizable and you can see it's happening in a distressed state of the world. So there was some evidence from 2008 and 2009 that QE actions in 2008-2009 seem to have bigger effects. It's hard to sort out how much of that is a function of market expectations and the Fed surprise, so in a way, some of the stuff that you talked about earlier Markus. How much of it was because you're in a world in which risk premia are high and when the risk premia are high, an asset purchase will have a bigger impact. I think Covid has been interesting because it tells us when risk premia are high, when the Fed steps in and does stuff, it's going to have a big effect. So you learn something about conditionality from this by looking for trends.

Markus Brunnermeier: But they didn't buy any Google bonds?

Arvind Krishnamurthy: And then that was also interesting right? This is the announcement effect, which is the same as all of the other things I've shown you. The announcement effects are very strong. In fact, in this episode the Fed actually did not need to buy, it simply stepped in and said we'll provide some support, markets reallocated themselves, and yields came back down, and I think that's also informative about potentially how to think about what's happening here.

Markus Brunnermeier: But was it Google or was it the guys who do this bond CDS, bond arbitrage, they were essentially put at ease or put in some extra capital. Do we know that?

Arvind Krishnamurthy: Yeah I think that's one way of thinking about it. Maybe. I mean, maybe this is where you're coming out, so let me just flip over to thinking a little bit about theory. I think this is where you're pushing Markus so first of all I think what should be clear for most of us who do research is that if you want a theory of QE, you really have to go away from a complete markets model and towards a segmented markets model, because QE affects are narrow, not broad, right. That jumps out from the event studies, so it's not changing the rep agents' SDF, it's changing the SDF of some narrower set of investors that were significant in a narrow market. I'll say another thing, which is also obvious, which is that if you really thought it was a broad thing, a macro calibration of Asian SDS will get you too flattened demand curve so it's not consistent with the data, it couldn't possibly be consistent with theory either, so this has to be the right way to think about the world when thinking about QE.

50:59
And so, then the research question is yes, this is clearly what we need to do in constructing models to be consistent with the data, but what type of model? And then, what type of model, it means what is the narrow market, who are the players, what are their constraints, that's the sort of stuff that we need to think through. And I'm going to talk through one particular paper and there's more I'd say in this work, but I'm going to talk about one particular paper which I view as

cutting edge of this type of work. This is Vayanos and Vila, I think it's Econometrica, last year. It's a model of the Treasury market yield curve that tries to deliver a risk premia that are functions of supply, that's what it's after and it does it by mixing two types of investors, one is a set of what i'm going to call safe passive investors preferred habit that investors, want to buy bonds of particular maturities and want to buy treasury bonds, and then another set of investors yield curve arm treasurers who are willing to go long and short along the yield curve to smooth out the impact of shocks across the yield curve. The arbitrageurs are particularly important because the price of risk in the Treasury market is a function of the quantity of risk held by the arbitrageurs, so there's a risk premium that shows up on the Treasury curve, that is linked very much to the SDF of the arbitrageurs, and what is the SDF of the arbitrageurs, well it's a function of how much risk they hold. Okay, so this is a I think this is a very nice paper because it puts two pieces that are probably relevant when thinking about QE: one is how narrow segmented market risk prices are determined, in this case by arbitrageurs, how safe assets are particularly priced, in this case by preferred habitat investors. So what does the model give you? It gives us a way of thinking about risk premia. It gives us things like when balance sheet constraints are tighter than risk premium or higher, that's some of the conditionality that I showed you, for example with that Google example. It also gives you a way of thinking about how you can get local effects duration, why is it that when you buy the five year bond, the five year bond was the most and the reason it happens in this model is because there are future supply shocks that the arbitrageurs have to bear and so, if I get future supply shocks to five year bonds I'm going to demand higher risk premia at the five year sector. I'll show you one picture and then I'll just talk you through some things that I think you can learn from this model, and maybe avenues for further work, so this is output from the model. And the output here is– take a look at the red line– this is if the Fed was to buy two year bonds, how does the entire yield curve, 0 to 30 years move. And what you see from here is that the two year bond yield moves the most and long term bond yields move a little bit less, so in a way that's consistent with some of that event study evidence I showed you so they can they can deliver effects that look like when the Fed buys two years, two years move a lot. Here's what if the Fed buys 30 years, you get a big movement in 30 years, you get movements all along the rest of the yield curve. Why, because every bond yield has duration risk and so when you compress the price of duration risk, so if you compress every bond yield, of course, the five year bond has one sixth the duration risk as 30 year bonds, so you compress that about a sixth as the 30 year bond, so you get SDF risk prices and you get some local effects that play out, that look very much like the data. Alright, so what can you do with this model?

54:49
Well there's different things you can do this model, one of the things that this model is allows you to think about is spillovers. So is the impact of the Fed's treasury purchases moving down 30 year yields, is it only in treasuries or is it broader? And to answer that question, what we need to figure out is that the arbitrageur who is buying long and short treasuries has an SDF that's priced in treasuries, what else is SDF pricing. Is it also pricing interest rate swaps, is it pricing say non-investment grade corporate debt? If that was the case, then you can draw a spillover to that risk price that is showing up in other types of bond yields. The model gives you a kind of a disciplined way of thinking about this, and although the paper doesn't do this, one could take the model, connect it to some of the data on some of the spillover effects and discipline how much the SDF is responding to this type of risk. So to me, from a theoretical perspective, writing asset pricing models that connect with the empirical event study evidence is particularly important and the big payoff is to discipline the asset pricing SDF, to trace out what else moves when a given asset is bought.

Markus Brunnermeier: I don't want to disrupt, but one aspect, one way to view it, is that you know markets are very segmented in crisis times, they are less segmented in normal times, so we would look at the markets, it would be very different across the cycle, in a sense.

Arvind Krishnamurthy: I think that's that's also right yeah. So for example, you could take–

Markus Brunnermeier: the habitat would be very connected in normal times, not connected along the maturity structure, but also across different asset classes, and that's also why I guess the Central Bank comes in and acts as an immediately connecting these markets, which normally the private market would do.

Arvind Krishnamurthy: I think that's exactly right, so I think this model will deliver that because once you put down and, basically, this is an intermediary pricing model. And once you put that down, it's going to tell you that during distress times, this pricing kernel has a higher price of risk, and so different stuff can move differently, whereas during normal times there's effectively more capital in the market, which makes market prices more integrated. And that has two implications: that would imply, in a sense, less spillovers during distress periods, but it'll imply smaller effects during normal periods.

Markus Brunnermeier: But then, if you go from an ex-ante perspective, if the intermediary sector knows when ever there's a crisis, there would be the Fed jumping in and connecting everything again, are there moral hazard considerations we have to take into account.

Arvind Krishnamurthy: No I'm sure I'm clearly yes. I guess the answer is clearly yes so I'll step back and just say, from a research perspective, I think if we develop models like this, that can put more structure on this, then I think we can go ask the next question, which is the question you're asking, which is a policy design question. This is my take on research, I think we're pretty good in the event studies, we're still working on this stuff.

58:29
We could do more and we need to do more, before we can get to the harder questions which are the questions you're raising. Let me just say, and I'm not going to spend too much time on this, we've been particularly interested from a central banking perspective and the impact of the Fed buying a given asset. But we know we can learn about the impact of the Fed buying a given asset by looking at somebody else buying that given asset and it's an example of that is Markus's example of the treasury changing insurance policy, but you can ask a pension fund going out and buying unexpectedly a bunch of mortgages, or someone changing your mandate and suddenly having to buy a bunch of corporate bonds. All of that is informative, and the nice thing about looking at those types of events or those type of experiments is that they're not commingled with monetary policy actions, so there is in finance, I think, a growing research area which tries to do this, which tries to think about intermediary SDF, market segmentation, specialized demands. Thinking about them for equities, as well as for corporate bonds. And this research has not connected to the QE work but it's very relevant for all of the QE work and taking this and connecting it to things like Vayanos Vila and putting together a sort of a systematic view of SDF that connects and integrates markets, I think can be very helpful in teaching us about how QE works as well. So that's just a plug for more of this type of research. Let me flip to the next set of things that I want to talk about, unless you want to stop me here. Because I'm done with asset pricing, I'm going to talk about macro.

Markus Brunnermeier: Let's cover macro too.

Arvind Krishnamurthy: Okay, so the big picture question of course is QE is what's the impact on things, bigger things, like employment and output, not narrow things like the price of a five year bond. And I'm just going to draw an analogy to conventional monetary policy, so you know conventional monetary policy research basically tries to look for identified monetary policy shocks and in different ways, tries to run some type of projection of those shocks on economic outcomes like output inflation and then trace out quantitative channels. And if you open the hood on what's happening there, what you're looking for is a policy shock that moves real interest rates, maybe changes the user cost of capital, then affects investment, changes an interest rate and also the other equation and then changes consumption savings behavior. And all of that, together, ends up affecting employment and output. That's sort of what we think is happening under the hood when we're moving conventional monetary policy. We draw the same analogy to QE effects, so, in principle, we can look at QE the same way. We have a QE shock, we have QE shocks that are fairly well identified. And one of the things about the QE shocks is that they're moving particularly prices in the targeted markets. Buy five year bonds, five year bond yields move, buy mortgages, mortgages move, buy corporate bonds, corporate bonds move. Okay, so not broad but particular. We can then run through the same channels, which is, if you move a particular targeted market, say, corporate bond yields: does that change the user cost of capital, for firms, does that change investment, if you change, say, mortgage rates, does that change household behavior in the mortgage market? Does that change household consumption? And that's the way in which we think employment and output is affected. The big picture is the same things at play, but the small picture one thing to keep in mind is we're changing interest rates and targeted markets. Okay, and I want to just drill down on that a little bit more to tell you that, because we're changing interest rates in targeted markets, the way we think about macro policy effects should be different than the way we think about them in the conventional space.

1:02:55
Arvind Krishnamurthy: So I'll make this point. I'm going to go back to the Google example I showed you before. In Covid, Google investment grade bond yields spiked by about 150 basis points, very significant. If I told you that the user cost of capital for Google went up by one and a half percent you would say that should have a big impact on investment. Now put down, though, the perspective of corporate finance on Google. Corporate expenditures will only respond to QE if QE affects the user cost of capital and the marginal unit of capital, so one of the things that is very clear about Google is that Google has lots of cash and the marginal source of capital for Google is almost surely cash; it's not the corporate bond market. What that means is that this spike of 150 basis points is probably irrelevant for Google's investment decision. On the other hand, now if I said that what happened was that conventional monetary policy brought interest rates down by one and a half percent both on corporate debt as well as on the return on Google's cash, then you'll say the user cost of capital for Google has changed and so investment would have changed. But understanding the QE works through these narrow effects and seeing that the Fed's corporate bond purchase program did was to lower corporate bond yields by one and a half percent, actually, if you look at this you say this corporate bond QE should have had no effect on Google investment because the marginal source of capital is cash and the price of cash didn’t really change with the section.

Markus Brunnermeier: But if the Fed cuts interest rate by 1.5%, Google's investment will not change either in a sense. Do you think because they give less on the cash that they will invest more?

Arvind Krishnamurthy: I would say that they would. Their cost of borrowing or the cost of cash is now changed so if I'm doing standard corporate budgeting at Google I'd say gosh my cost of capital just moved by one and a half percent.

Markus Brunnermeier: That would pay out the cash, because the constraint, based on ideas and other limits rather than financing constraints?

Arvind Krishnamurthy: Okay, I mean that now you're telling me that Google's production function is very special.

Markus Brunnermeier: Probably they can't just scale it up.

Arvind Krishnamurthy: The same way, maybe it happens slowly. Okay, yeah, I don't know Google's production function well enough so I'm trying to just make a corporate finance point about Google, in particular, and about an investment grade firm, in particular, which is that just because you bring down their corporate bond yields doesn't mean you will have an impact on investment.

1:05:58
For an investment grade firm that has other sources of financing, it may not matter at all. And in fact, there's actually reasonably strong evidence for this having no effect. Two papers I cite here, which basically look at firm behavior around the Covi crisis give you strong evidence that there's sort of a "no effect" here, that all we're doing is shifting around financing terms but there's no real investment effect.

Markus Brunnermeier: But here, this particular Covid thing, you have to wait until Google wants to issue new born, this was too short, essentially, March 2020.

Arvind Krishnamurthy: Maybe that's the answer, which is that Google isn't rolling over debt here, and if Google was rolling over debt, then maybe it matters but, again, the point for Google is that it has lots of cash.

Markus Brunnermeier: But my understanding is the reason that they issue bonds to hold a lot of cash all protects arbitrage reasons, they keep some cash in Ireland and they have to issue some bonds.

Arvind Krishnamurthy: And so, then, once you have the cash, you can use the cash. I mean again we sort of know I'm not going to go too deeply into this, I think the Acharya Steffen Paper makes the point that we know that, during this period, firm structure brought down bank credit lines. And so it's not the– the alternative is not cash, it was a credit line. That was the source of financing, but I make the same point which is if the cost of that credit line didn't change and that was the marginal cost of financing, then, by bringing back the investment grade bond yield down you're not really having an effect on the firm.

Markus Brunnermeier: Will you talk about this Dan Greenwald paper as well, where essentially he argues that because the Fed intervened and brought their yield down on their corporate bonds, it made it possible for the banks to free up some capacity to link to SMEs and this was a big macro effect, essentially, so you subsidize essentially, the corporations through QE, corporate bond QE, and suddenly they didn't need to go to the banks anymore, because the

corporate bond market and then the banks have the capacity to lend to the smaller companies and you wouldn't see it on the big firms, but you see it on the small office in SMEs.

Arvind Krishnamurthy: Good okay yeah I will, I will say something about that, let me just make one more point here, and then I want to go and I'm just making this point just to highlight that the way to think about the macro transmission is more nuanced than we think about with conventional policy. So i'll take the same example, pick a firm with five year bonds and five year bank loans. And suppose, let's suppose that bond investors increase the risk premium they were charging on corporate bonds. Let's suppose banks also increased the spreads they were charging their loans, but the bond investors increased it more. Since the firm is going to tap the lowest source cost of capital, which in my example here is a bank loan, if you're thinking about QE that wants to impact corporate investment, you should actually target the financing with the lower yield, the less fire-sold asset, which is in a way, counterintuitive. When you first think about it, you think the corporate bond yields are selling off, but if that's not the marginal source of financing and bank loans are selling off less, then find a way to make bank loans cheaper, if you want to affect investment.

1:09:38
The point being that when we go from asset pricing to macro when, and we think about firms, we kind of have to put some layer on here to make sense of how to think about QE. I think I mentioned this before there's actually nice evidence, also from Europe , which is that the corporate bond purchase program lowered bond yields, but had limited impact on creator firms investment. The effect that that had, and this Markus is related to what you just pointed out, is banks that were more exposed to treated firms increased lending to other firms, which is a spillover effect and that seemed to be the impact that happened. And so that may be a different way of thinking about some of these corporate bond purchase programs that is more linked to the Vayanos Vila model. What you're doing is by going out and buying distressed debt, you're changing the capital position of banks, the quantity of risk that they're holding, changing their SDF and then making them more willing to lend to others. And that's like what you just mentioned about Greenwald's paper about SMEs. And that seems like a kind of a very plausible way of thinking about the world, so it might be that the important effect of QE is running through an intermediary SDF that determines asset prices, which is different than thinking about how firms are responding to this sort of stuff and this is very similar to thinking about Vayanos Vila, if you think that there's an intermediary SDF that determines asset prices and you're running through that intermediary SDF, then that's the way in which you're impacting asset prices so if I took an intermediation channel thinking about how the Fed's QE is working, then what the Fed should do is purchase the fire-sold assets to shore up the balance you do the intermediary and lowering prices. So I'm just going to make a broad point, so suppose I told you that the world was a mix of corporate financing type issues as well as intermediation issues. Then maybe what you want to do if QE is a tool of monetary policy is you want to buy expensive bonds in normal times and cheap bonds in distress times. And what I mean by that is in distress times it's intermediary SDFs and spillovers that's the mechanism through which QE should be working. In normal times it's not an intermediary SDF, it's directly different asset markets and say lowering the yields on corporate bonds versus bank loans so by the cheaper source of financing, which is the expensive bond in normal times and then flip over and buying the cheapest bond in distress times. I mentioned this, I mean it's sort of provocative, it's just a way of making the statement that to go from the asset pricing to the macro, there's more modeling of firms and banks that needs to be accounted for, and I think doing so might lead you in different directions about thinking about optimal policy. So in my mind there's sort of ample room for more modeling work here to interface with data patterns. So maybe this is clear from what I've said. I feel like we're quite far from a compelling macro finance model to study QE. You know, in a way the simple

thing to do would be to take a macro model with a risk premium, like a term premium and imagine that really impacts the term premia. I think that's wrong. You can't do that because it's clear that from the asset pricing evidence QE is impacting risk premia, but then understanding how that is affecting firms and household behavior has many steps that need to be accounted for more systematically, because QE is working through narrow channels, and so in my own mind i'm kind of uncomfortable with where we are with microfinance models studying QE.

1:14:09
And in the poll that you had given before, I feel like this is the place where we know the least, maybe we're not even there to build up these models, but this is the place in which we really know the least, where we could really do a lot more research. So if you're asking me I think research here we're still at some level of insight stage, we know that asset market targeted matters for transmission. We know it's more subtle than if you just buy stuff, good things happen, we know that crisis interventions are more powerful than non-crisis inventions. And then the last thing that I'm going to say is, we also know that communication matters. And I'm going to say a little bit more about that, maybe in the context of QT.

Markus Brunnermeier: Perhaps one minute.

Arvind Krishnamurthy: Okay, so I think this is really hitting the end here, so this is the last thing I want to say. I think one of the things that is also clear with QE announcements, is that it comes coupled with indications of conventional policy and the reason is because markets are not sure whether QE is just about asset purchases or it's about other stuff as well. We're sitting in a world today in which we're thinking about quantitative tightening and it is likely the case that markets are more confused about the reaction function on conventional monetary policy now than ever before, partly because of what has happened with inflation. So I think a lesson from some of the past QE research is that in that environment it's probably going to be the case that any actions or QE are also going to be informative about the conventional policy reaction function, so that there's going to be strong communication effects. If you're asking me a lesson and sort of an insight lesson that I learned from some of the research that's relevant to QT is be very careful with communication because we're unsure about the conventional reaction function almost surely announcements about QT will inform the market about conventional reaction functions, and so it pays to be even more precise in separating those two things.

Markus Brunnermeier: So you expect another taper tantrum.

Arvind Krishnamurthy: I'd be worried about a temper tantrum if we don't handle communication thoroughly, I think this is the worry sitting here today.

Markus Brunnermeier: So if you want to tighten now you would rather tighten with interest rate, rather than…

Arvind Krishnamurthy: The Fed's been working super hard and trying to delineate these two policies right there sequencing strategies, etc, but I think what I have learned to say from the taper tantrum is and generally from the stuff is that as much, as hard as they try, there is still confusion.

1:16:59
Markus Brunnermeier: Let me come back for two minutes or three minutes, just to some questions to summarize their main questions at the end. Of course what you're proposing as a

macro model, it's a very challenging exercise, because when you go to segmented markets, you have many stakeholders, each segment of the market has its own well share and that is a challenging exercise, and I think probably with machine learning and other avenues we might be able to have a bigger models and go to the data with them and come to these insights, but it is a big challenge, but I was stuck by one thing that you did not say. Perhaps if you can summarize a wishlist at the end. You did not mention any point in your talk about the zero lower bound. And that was the initial starting point for QE that we said. But in any of these arguments brought forward there was no reasoning that we have to do it when we hit the zero lower bound. So all of these reasons, you brought forward, we could do it at 2% interest rate, 3% interest rate, too if you think “oh there's a friction there and markets are segmented and there's some problems here, we can fix it with smooth quantitative interventions.” Do you agree with it, or do I push too hard?

Arvind Krishnamurthy: It's clear that QE was born, because of the ZLB. We have learned a lot about QE and maybe we have more to learn about QE and I think we should be open to asking the question: what is the appropriate role for this new policy?

Markus Brunnermeier: But it has huge– so come back to my redistributive monetary policy– it has huge redistributive consequences, and then you open up the whole political problems, the Central Bank comes into it. If you favor one sector to another sector, if it's not a political movement for everybody, then it's hard to say “okay, we favor this particular segment in the market, because the financial impaired in order to help them out” and then raise a lot of political…

Arvind Krishnamurthy: Pressure to look like industrial policy, yes yeah.

Markus Brunnermeier: And finally, let me just ask: perhaps you can go to the wish list and add just Laura Allen’s question with it. Ben Bernanke at some point said QE gives you another 3% extra policy space beyond the zero lower bound. Would you make such a bold statement, or is there any way to quantify it, or do you think it's much more nuanced? You have to look where is the bottleneck and intervene there and rather than trusting this like an average macro model, it just relaxes the zero lower bound.

Arvind Krishnamurthy: Yeah I don't feel like the data allows us to see or anything that I've seen allows us to say 3%. It feels much more nuanced and feels like specific markets and, as I said, it feels like specific times. It's clear, for example, that Covid corporate bond purchase program had a huge impact, so this must be a conditional statement as well.

1:20:08
Markus Brunnermeier: As you said, you know you have a huge impact. It didn't impact the economy ultimately. So we're helping out Google…?

Arvind Krishnamurthy: Didn’t impact Google. But it could have impacted it through the mechanism that Greenwald proposes, which is that it freed up space and that impacted the way in which banks make lending decisions.

Markus Brunnermeier: Perhaps we end here and you just give us a one minute summary of your wish list.

Arvind Krishnamurthy: Yeah, so this is me taking stock of where we are on QE research. I actually feel like we have lots of very good asset pricing work on this on QE and I guess if I was like a planner allocating research time of all research economists, the staff, I'd say we've got this one pretty well covered. I think we could do more here and sort of in a sense, we need to do more here because it's what's going to inform us about spillovers. We have far less evidence on macro consequences. I mentioned a couple of these bank lending papers, we have far less than we need, and the reason why more of this is useful, is because we want to connect the asset prices stuff with real stuff and we need data to help discipline models. And then you know I think we're still in very early stages of positive macro models and part of it is what you mentioned Markus. It's hard to deal with these models, but actually I think we have made good progress on dealing, on being able to construct multi sector financial market models, with different SDFs, so to me it's actually not a computational issue it's more what's the right model to write down that's consistent with the data. And if we do all of that, then maybe we can answer the other questions, which are the questions you have raised a couple times, which are the normative questions, about optimal policy and policy communication, moral hazard, ZLB, all that sort of stuff but I'd like to see much more of this to get to this point first.

Markus Brunnermeier: Thanks a lot Arvind, I think we have a lot of work to do in the next five to 10 years I guess. It was so fascinating to see you know how we put things together, I think you're a very nice structure in your talk and that makes it much clearer when the open holes are and what we still have to do okay.

Arvind Krishnamurthy: Thank you for listening to me everyone, and thank you for having me Markus.

Markus Brunnermeier: Thanks, thanks everybody bye bye.