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Paper Session: Markets

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Discussants:
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Joe Haubrich:

Welcome back everyone. Our first presenter in this first academic paper session is Gorkem Bostanci from the University of British Columbia with his paper Business, Liquidity, and Information Cycles. Unfortunately, the discussant Prabhala couldn't make it, so we're adjusting the schedule by a little bit. Please bear with us.

Gorkem Bostanci:

Right. Thank you for having me here. This is joint work with Guillermo Ordonez from University of Pennsylvania.

So stock markets play two critical roles in market economies. First, they aggregate information for resource allocation. So stock traders spend money and resources to get some information about which firms are going to be profitable in the long run and prices emerge from their interactions. So by looking at the stock prices that emerge from these interactions, we can get a window to their wisdom about what these stock traders might be thinking.

Secondly, they provide liquidity. So stock traders who are in need of some quick cash can offload their stocks and make money off of that, and they can use this to meet these liquidity needs. And you might think that how much agents, these stock traders, rely on stock markets for liquidity will depend on how well they can access this liquidity from the funding markets, from the banking sector.

Then this raises some questions. Does the use of stocks for liquidity enhance or weaken their role in terms of providing information about what the traders think? And how does liquidity distress originating in the banking sector affect the price informativeness? The price informativeness here refers to how much you can learn about which firms are going to be productive in the future by looking at the stock prices and how does the information content of stock prices vary with the business cycles? Since we know that business cycles like the recessions tend to be periods where liquidity also is in distress, you might imagine that the information content of stock markets can vary with how the business cycle is going.

So in order to answer these questions, we're going to do three things in this paper. On the theoretical side, we're going to build a model of stock trading and misallocation. On the stock trading side, we're

going to allow for endogenous information acquisition and endogenous noise. And in this economy, the real sector who decides on how to allocate capital across firms, will learn from the asset prices available in the economy. Second, on the empirical side, we're going to this estimate a concept of a price informativeness using data from several countries. This estimated price informativeness will exhibit cyclicality, good times prices are more informative, bad times, they're less informative. And we're going to decompose the fluctuations in price informativeness into contributing factors. This is something our structural approach will allow us to do that.

Lastly, on the quantitative side, we're going to calibrate this model for the US economy. We're going to show you that liquidity shocks distress in the funding sector tends to coincide with technology shocks, our usual recessions, and they're going to amplify these technology shocks up to 22%. And we are going to show you that recessions in this world can be cleansing or sullying. In particular recessions without a funding distress, without a liquidity distress will lead to more informative stock markets and the allocation will improve. So it's going to be a cleansing recession. But if this recession coincides with liquidity distress in the funding markets, then price informativeness will go down, allocation will worsen, so you're going to have a sullying recession.

So before I move on, I'm going to give you a bird's eye view of what we're trying to do. I'm going to show you a very simple RBC model. This is not the model that we have. It's just a simple one to demonstrate what's going on in a simple fashion. Imagine a classical RBC with heterogeneous firms. The first line, you have a household solving a consumption saving problem. In the second line, there's a decision maker trying to maximize profits of the individual firms indexed by I. This would indicate some equilibrium conditions. In particular, the second one would tell you something about how the marginal product of capital across firms has to equate to a market interest rate.

This is both an equilibrium condition and a condition for efficiency, marginal product of capital equalizes across participant firms. We're going to ask, what if the productivity term here that denotes this ZI will denote the idiosyncratic productivity of the firm? What if that idiosyncratic productivity was not known perfectly by whoever is making this capital allocation decision, but instead it had to be inferred? In other words, whoever is making this decision has to form an expectation of the ZI given the market the stock prices available in the economy. Most of our effort in this paper is going to go to modeling that expectation term in detail, and we're going to leave the rest of the model as simple as possible. And you can imagine that the extent of which this expectation differs from the true ZI, we are going to have a misallocation of capital in the economy.

So let's go on the model. First, a broad overview of what's in the model. There's going to be households that are your usual RBC households. There's going to be some heterogeneous firms indexed by I, and there's going to be a mutual fund in between who's responsible for taking the capital owned by the households from them and renting them to individual firms. So deciding KI how much capital goes to each individual firm. This mutual fund is a theoretical concept that stands in for everyone that is involved in this capital allocation decision, managers, banks and credit ratings agencies, anyone you can think of.

In the meantime, there is going to be some stock traders hanging around in this economy who are trading the shares of this firms in between themselves. Their trading does not have any direct impact on the real side of this economy, but their trading will result in some stock prices, one for each firm, and this can be used as information by the mutual fund to decide how to allocate capital. So more

information flows from this traders to the mutual fund. The fund will make a better decision of allocating capital across firms.

So I am going to now throw at you 20 Greek letters and parameters and ask you to remember them for the rest of this talk. So we have, as I promised, stock traders in this economy. Let's start by describing them. There's going to be a fraction of them represented by gamma, we're going to call them day traders. And one minus gamma of them, we will call them night traders. These are types. Everyone knows their type. And day traders refer to those traders who think that they may have to sell what they have, as the shares, early on. While night traders think that they're going to keep holding onto the stock. This gamma will be an aggregate state of the economy and it will follow a mark-off process. So some periods there's going to be a lot of people who think they may have to offload their stocks early on and hence have to pay attention to how easily can they offload their stocks. And some periods there's going to be fewer of them and we are going to think of liquidity, distress, banking, distress funding distress in this economy through that gamma. Liquidity distress will be a period where gamma is large. Stock traders pay a lot of attention to how quickly they can offload their stocks and how easily can they offload their stocks.

Traders will have CARA utility functions, consumers have CRRA. On the technology side, there is going to be a continuum of firms whose stocks are traded on the market. These firms will try to maximize. Their profits are going to be represented by equation. They have two types of capital. KI bar represents installed capital that cannot be changed. It's there, fixed. And KI that has to be rented every period from scratch and there's an adjustment cost indicating some nonlinearity, some concavity on the production function. It's an odd structure. Why do we have this odd structure? For this, let's look at the assets available in the economy. There's going to be three assets, capital, firm shares, and a foreign bond that will primarily serve as a currency.

Capital is interesting, capital will be owned by consumers and will eventually have to make their way to firms and mutual fund will facilitate this transaction. We're going to make it so that, and this refers to not the installed capital which is fixed at the firms. This refers to KI, the flexible capital that is owned by the households. Mutual fund will have an odd structure in this economy. When interacting with the consumers, mutual fund will act as if it's in a competitive market and this transaction will accrue all the surplus to the households consumers. On the other hand, when the mutual fund is interacting with the firms, it'll act as if it's a price-discriminating monopoly, and it'll essentially offer a take-it-or-leave-it contract to the firms that ensures all the exposed profits the firm makes accrues to the mutual fund. So the firms do not get to keep any profits associated with renting KI. All they get to keep is related to KI bar.

How does this help? This will ensure that how much capital is allocated to the firm will not influence how much profits the firm gets to keep. Therefore, how much payoff the owners of that firm, the shareholders end up receiving from this firm. In its absence, this would lead, we would have a feedback loop. If the firm has a higher price, suppose that influences how much capital is allocated to that firm, which in turn influences this price because that influences how much the traders expect to get from having owned this firm. This way we cut that feedback loop in step one. Prices will have an influence on how much capital is allocated to the firm, but how much capital is allocated to the firm will not influence the price of that. This will ensure a simple analytical formula for the pricing function. How are the pricing formed? Prices are formed and it's going to provide tractability for the rest of the paper.

And this is one of the major contributions of this paper. These stock trading models in the tradition of Grossman and Stiglitz have very nice structures as long as things are additive, shocks are normally distributed, you get a simple linear pricing function and there is analytical tractability. But we are trying to put this into a nonlinear production economy, which quickly leads to the breakdown of this delicate structure of a linear pricing function. This way, we are preserving the simple linear pricing function in a complicated nonlinear production economy.

So this was how capital works and explains why we have this odd production technology. How about the ownership of these firms? Well, the stock traders will own the shares of these firms. The payoff a night trader gets by holding one stock will be a stock is going to be ownership of one unit of KI bar. So if you're a night trader who is willing to hold on for a long time, your payoff is ZIN, the productivity of this firm, plus the price of the stock in next period.

On the other hand, if you're a day trader who may need to offload early, your payoff has the productivity and the future price. But in addition, a reduced form penalty, ZID, that refers to how much of a loss you have to incur because you have to sell in a short amount of time. For now that ZID is going to be an exogenous shock. It's going to be a reduced form object. But in the paper week show a micro foundation where how you can micro found the ZID as a fee a dealer would charge you if you have to offload your stock early. And we are going to show that that object, that ZID, will be high for stocks that have high price volatility in the short run. So holding a volatile stock is costly if you're someone who may have to sell your stocks relatively early on.As I said, there is an additional bond that just serves as a currency, it's not going to be important.

How about on the information side? So ZIN and ZID are what the traders care about. ZIN was the productivity of the firm. ZID is the liquidity penalty you have to pay for holding that firm's stock. ZIN will have an aggregate productivity term, capital Z, a term that can be learned, theta IN, and an epsilon term that cannot be learned. How can the traders learn this learnable part theta? By paying an information cost. Similarly, ZID has a learnable and an unlearnable component. How can you learn the learnable component? By paying a cost. And the cost of acquiring information, both from the day and night trader's perspective is going to have a nice structure that allows for simple expressions.

To get some intuition, let's see what type of a outcome this leads to. There's going to be four types of traders in the end, informed, uninformed, day trader, night trader. On the left-hand side you have the demand functions for night traders. They care about, and this is a simple excess return divided by variance structure. They care about ZIN and PI. Day traders have the same structure except that they have the ZID as well. They care about those short-run fluctuations. In addition, top line refers to informed people. Informed people get to condition their expectations based on data because they have acquired information, paid the cost to learn data. But night traders, sorry, uninformed traders do not know data, so they rely on the market price to infer what the informed traders know about data.

There is a simple market clearing condition, and information acquisition decisions are simple. Agents balance the cost of acquiring information with the benefit of acquiring information in terms of reducing their uncertainty. Real sector is very simple. Consumers consume and save, mutual fund allocates capital as best as it can based on the information available through the stock prices.

This is the equilibrium definition. I want you to pay attention to only two things. One, we are going to be looking at the first element of this definition. Price is going to be a linear function of theta ID and theta IN. You can show this by a couple of years of algebra. Theta ID was what the agents thought the liquidity of this stock is going to be, theta IN is what the agents think the productivity of the firm is going to be.

So price tells you something about both. And it's impossible to distinguish whether the price is high because stock is liquid or because the firm is going to be productive. This is going to create some information friction. How much you can learn about the productivity of the firm. What the real sector really cares about depends on the coefficients in front of theta IN and theta ID.

The second thing I want you to pay attention to, there's going to be two aggregate shocks in this economy. Z is going to represent your classical RBC productivity shocks, and gamma will follow a Markov process. As I said, that's the shock to funding distress. This is a shock to the composition of traders. What fraction of traders are day traders or night traders? Why do you care about this composition? Because you will see soon how much you can learn about the theta IN from the prices. How much you can learn about firm productivity from the prices, depends on how much informed trading is done by night traders relative to how much informed trading is done by day traders. More day traders, there is price becomes a better signal for liquidity, but a worse signal for productivity, a worse signal for the real sector.

We are going to define a simple price informativeness concept, which essentially tells you on the numerator how much reduction in variance you can achieve by observing the price, relative to how much reduction in variance you could achieve by actually acquiring the information. So this number is between zero and one. It tells you how good it is, how useful it is to look at the price relative to acquiring the information itself. If it is one, prices are as good as acquiring the information directly. If it's zero prices, prices give you almost nothing relative to acquiring information directly. And under some assumptions, we can show you that this price informativeness depends on only four objects from this model. The variances of productivities and liquidities across stocks, something that we are going to just directly observe. And the phi ID and phi IN. if you remember, these were the coefficients in the pricing function, the loadings of the liquidity and productivity.

These are equilibrium objects. They're complicated, they have complicated expressions of the parameters of the model, but if somehow we could measure these phi ID and phi IN directly in the data, then we don't have to solve this complicated model in order to compute this PI. And that's what we do. Oh, that was unexpected. Oh, to go back. So on the empirical side, what are we going to do? We're going to estimate this pricing function, it's a linear function of theta ID and theta IN for each country year pair. So we can get measures of these phi's coefficients, treated as like a simple linear regression of price on theta ID and theta IN. Secondly, we're going to internally calibrate the remaining parameters and we're going to recover the composition of traders as a hidden state of the economy. It's going to be backed out from what we can observe. We're going to use data on stock prices, analyst forecasts and macroeconomic conditions.

What is going to be the estimating equation for pricing? We're going to essentially regress the stock price at a point in time, residualized for a bunch of things that we don't have in the model on a measure of productivity expectations taken as analyst forecasts for earnings and a measure of liquidity. Ideally we would have volatility expectations for these stocks we don't have that, so we're going to use past volatility as what the agents think how volatile this stock is going to be in the future. So we're actually asking to what extent price co-varies with what the analysts think about the productivity of these firms versus their past volatility. Does the price co-vary with fundamentals? Or does it primarily co-vary with the short-run market fluctuations? This is what you would get by estimating this price informativeness object for the US economy. And it does some of the things that you expect it should do.

We have the biggest drop in our sample during the COVID crisis and other big drops around financial crisis, dot-com bubble and a extended drop in this measure around the savings and loans crisis. This is just a demonstration for us. We are doing it for more than 20 countries in this paper. And when you do a simple panel regression across all these countries, you would see that our price informativeness measure, as the picture already showed you, is quite cyclical. It tends to be high when the economy is in a boom, but looks like it is also high when the funding liquidity is good, when the banking sector is doing relatively well relative to the rest of the economy.

So right now we cannot really tell is the price informativeness high because of the cycle or because of the liquidity conditions. So we are going to try to disentangle that in our structural model. In terms of the calibration, it's a quite interesting calibration. You are trying to recover a hidden state. I would recommend you to take a look at it. I should just also add that in the baseline model, the only source of information for the decision-maker was the stock prices. Obviously that's an extreme assumption in the quantitative model, we had other sources of information and allow that maybe the decision-makers already knew some of the information that the prices reveal. And we discipline these additional source of information by looking at the price investment correlation that cross firms amongst other things.

So once we calibrate this model, this slide kind of summarizes our main result. We are looking at two different types of recessions. Let's think of the US economy. Let's think of the solid line as the great financial crisis. Two things happened. There is a big drop in aggregate productivity, and there is a big increase in the fraction of day traders. There's funding liquidity distress which leads to stock traders pay more attention to the liquidity of the stocks. What happens? As a response to this? Traders acquire more information. Lambda refers to the fraction of traders that acquire information. Because information deteriorated due to the entry of this day traders, agents, the stock traders respond by acquiring more information, but this response is not sufficient to undo the initial damage due to the change in the composition of traders, price informativeness still goes down. You have a big output drop and a big investment drop. The question is, what if we had a different type of recession? What if this trader composition did not change what in a counterfactual scenario. We would still have an increase in information acquisition, not as much price informativeness. If anything would go up, prices would be more informative. Output drop would be about 20% smaller than otherwise. Investment drop would similarly be smaller. In other words, when the Z-shock when RBC recession coincides with the liquidity shock, things become at least 20% worse than they otherwise would've been.

This is a testable implication and we have a panel data. What we do here is we are essentially regressing whether how PI co-moves with GDP growth across countries and measure of the Z-shock, the cycle, and various liquidity measures. One liquidity measure in each column, pick your favorite one and all of them are signed in a particular way that a higher number refers to higher liquidity in the economy. We have how the banking stocks perform relative to other stocks. How are the bank capitalizations and so on and so forth. And what you see is, once you keep liquidity fixed, a recession actually leads to higher price informativeness. There are cleansing recessions, but once you keep the cycle fixed, higher liquidity actually coincides with higher price informativeness. This is consistent with the counterfactual analysis that you have just looked at. Recessions on their own improve allocations, but when they coincide with liquidity distress, they make allocations worse.

If we do some additional counterfactual exercises, I'm not going to go into detail. The key message is the fact that traders endogenous to respond to initial shocks by changing their information acquisition, actually really helps alleviate the initial shock. Shock could be much worse if the stock traders couldn't acquire additional information in bad times. If you made information easier to access for night traders

by releasing more information about fundamentals, recessions would be less damaging. But if you provided more information about the liquidity of these stocks, maybe information about the market transactions and whatnot, you would actually make crises much worse by allowing traders to trade more aggressively on the liquidity of these stocks. I'm going to just conclude in 10 seconds we build a model of asset trading with endogenous noise with heterogeneous traders, put it into an RBC setting and structurally estimated the implied stock price informativeness and show that it declines during recessions with liquidity distress, recessions without financial distress, makes prices more informative, improve allocations. While recessions with financial distress, make prices less informative and magnify the output losses. Thank you.

Joe Haubrich:

Thank you. We have a few minutes if there are questions from the audience about the paper.

Speaker 3:

Thank you. Excellent presentation. Really enjoyed it. Thank you. I have a couple of questions regarding what your results mean for ex-under perspective about assessing a boom. So in some sense your results seem to imply that if a boom is debt funded, then you should expect that the price informative measure should drop once that boom goes over, which actually means that there's a cost that comes from that debt funding. It seems like that's a new channel you're identifying here that is actually really interesting and insightful. And then the other question I had is what do your results imply about the growth in index investing? It seems to map into your composition of traders and participants in the markets. Can you speak to that a little bit as well?

Gorkem Bostanci:

Let me start with the second one. That's the second project on our table To understand the implications of indexation. What it implies is there are two ways of looking at our trader composition. You can either think of it as actually the people are changing in terms of some people who didn't pay attention to liquidity now starts paying attention into liquidity versus not. Or you can think of it as everyone pays a little bit of attention to liquidity, everyone starts paying a little more attention to liquidity in bad times. Either interpretation would work in the logic of the model and this makes empirical mapping a little more difficult than it otherwise would be in terms of what exactly is the measure. That's our reasoning for taking a look at the indexation behavior.

In this paper we focused on the cyclicality of this object. Indexation is something that we think more about the trend of the financial market activity, so I'm going to leave it for the next project to say more about how, but in short, if you think of indexation as less information production in the economy or less attention paid to fundamentals, these things would be in general detrimental to price informativeness in a model like this. In terms of the debt funded move, we haven't thought of it. In terms of how we got to this point, our analysis is primarily about where we are right now instead of how we got to this point. It could be interesting to see what if a sustained period of high funding liquidity coincides with high productivity, what would that imply as a starting point for a recession rather than another starting point? So far what we have done was to keep the starting point constant, and see where we end up based on different shocks, but it would be interesting to see how the starting point influences those and the magnitude of those losses.

Joe Haubrich:

Any additional questions?

Speaker 4:

Hello? Can you hear me? Yeah. Yeah. Terrific paper. Very interesting. But I'm struggling to think through the logic of your mechanism with the fact that now we see kind of like private markets taking a larger role in the economy and there is no, the information production channel that you highlight. Have you thought about how these allocations that depend on activity that doesn't go into the public market that provides the signals that you rely on, how is that going to change? And my understanding is also the U.S is particular that the stock market is a larger source of financing for corporations vis-a other jurisdictions. So how do you think about that?

Gorkem Bostanci:

I'll start with the second one again if you haven't actually quite an interesting result when we measure, and I told you we estimate this price informativeness measure for various countries, what we have seen was the variation across countries in price informativeness in good times is quite small relative to how much it varies between good and bad times for a given country. This was initially surprising to us in that our initial expectation was to find high price informativeness levels for a market like U.S relative to a developing country. Maybe we did not find that. So we started developing theories after the fact. After observing what we have found, what we think is happening is when you look at the U.S stock market, the selection is relatively less in the sense that U.S stock market is much larger than some of the stock markets that you observe.

For example, another country in our sample is Turkey, which has a much smaller stock market, fewer companies and percentage of the economy is in the stock market, which leads to the companies that show up in the Turkish stock market to be also the bigger companies and companies that are probably followed more actively and paid more attention to. So I think a direct comparison of the price informativeness across markets has to take into account which firms select into being in the stock market in the first place and whether a ton of firms exist in your stock market, some of which people haven't even heard of versus on the top 10 20 most well-known and invested in companies are in your economy. This is why we think we find little variation across countries, even though we would think that the U.S stock markets function better. Can you remind the first question one more time?

Speaker 4:

No, I was thinking about the role of private markets and how you think about their allocation and how these markets, role markets. You say private markets, think about companies that don't list in the public market and you have all the financial system like banks and other stakeholders.

Gorkem Bostanci:

So this is a model only of the public sector of the US economy. Maybe I should have clarified a little earlier on. And then some of the big drops in output are obviously the big drops in output of the public sector, not as big drops in the aggregate US economy within average recession. In this structure the model is designed as if the entire economy consists of the public market and doesn't allow anything about the private market. We leave it outside of the model because we did not know a smart way of

integrating it. You could always integrate it as like there is something else going on with this size and then we don't really pay attention to how that reacts to what's happening in the public market. That was a possibility to, but we didn't go that route. Something interesting that we have found by looking at these private markets is we were interested in asking the question of if prices indeed provide information for real decisions, can we look at the economy and see whether the firms with high prices obviously controlling for a bunch of things actually attract more investment or are they doing more investment?

Are they more able to attract investment in the first place? And we use various measures to measure that. One of the measures that we have used was the corporate bonds. How much of a return a company has to promise to attract funds and how are their funds rated with regard by the credit ratings agencies? And we do find that firms with higher stock prices, obviously this is again the public sector sample firms with higher stock prices tend to be the firms who has to pay smaller returns on the corporate bonds they issue and whose bonds are better rated. In a way, this is our intuition about they seem to be the ones who can attract funding from the private markets easier relative to companies with smaller stock prices. But then again this is just a statement that we can make about the publicly traded firms.

Joe Haubrich:

Thank you Gorkhem. Our next presenter is David Rappoport from the Federal Reserve Board of Governors with his paper credit services and Economic Uncertainty followed by a discussion by Leland Farmer from the University of Virginia.

David Rappoport:

Okay, thank you very much and thanks for including our paper in the program is a great honor and privilege to be here. This is joint work with John Geanakoplos, and of course the usual disclaimer applies.

Okay, so create conditions are central to economic activity and economic policy, monetary policy, macro-provincial policy, housing policy and others. Credit conditions are traditionally described by the risk-free rate and a single spread, but we know that credit spreads depend on multiple credit terms. You have leverage, you have rating, maturity, governance. This is going to give rise to a credit surface that captures all these dimensions and map it into the credit spreads that we observe. And today what I'm going to be focused on is on the leverage dimension. So we are going to have, although our premise is that this surface is multi-dimensional, we're going to be looking at one dimension and our research agenda is trying to look at these other dimensions going forward.

So here is a picture a credit surface. So I have here the spread on the Y-axis. I have a leverage ratio on the X-axis. I'm using the loan-to-value. And the point that we are going to try to convince you of is that in periods of high uncertainty, these relationship between leverage and spreads not only moves up that we understand that in higher uncertainty regimes spreads are going to be higher but the relationship between different spreads at different points in the leverage distribution is also going to change and this relationship is going to get steeper. So the higher the leverage, the higher the increase in spreads when there are uncertainty shocks. Okay?

Now we are going to ask a couple of questions about this phenomenon. One is what type of uncertainty shocks are going to create these steepening effects that we actually are going to look in the data. So for

example, think about the Merton model where you have a log-normally distributed value for the firm. The firm is the collateral for the debt. If the standard deviation of that log-normal distribution increases, is that going to lead to the steepening effect that we are thinking? We are actually going to give you much richer characterizations of the type of changes in uncertainty that are going to lead to this phenomenon. But the like ninth inning of writing this paper, what we also realize is that we can ask the flip side question, what is that These movements in credit spreads are telling us about the distribution of collateral values? And we are going to show you how you can use bond prices or create spreads to actually invert the information that we see in financial markets to learn about perceptions of financial uncertainty from market participants. Okay? In fact, we are going to argue that you can actually back out the distribution of firm returns from looking at the changes in bond prices or credit spreads.

Okay, I am going to skip the relation to the literature. We again, the interest of time, but there is a long tradition to understand economic uncertainty on economics. We understand that more uncertainty to higher credit spreads but we are interested in the cross-section of credit spreads and there are also a rich leader who are thinking about credit spreads and also comparative statics of the type that we are going to be using here. Okay, so the outline for the rest of the talk, first I'm going to show you some evidence using corporate bonds from the U.S. Then I'm going to present a simple framework that we use to think about pricing uncertainty and create surfaces. And then depending on how much time I have, I'm going to try to describe the insights that we have learned in terms of how leverage is related to the shape of this credit surface and also how uncertainty shock changed the credit surface.

Okay. So the evidence is going to be from corporate bonds. We are going to use data from the constituents of the ice bond indices. These are also the Bank of America or Maryland indices as they have been changing ownership and we are going to be using the option adjusted spread. These are the constituents of the investment grade and high yield bond indices and leverage ratios are going to be measured using CompuStat and CRISP data. The description here is going to be terse in the interest of time, but I invite you to look at the paper in more detail if anything sparked your curiosity. And we are going to look at a sample of domestic non-financial firms rated triple C minus or above, and to try to remove the maturity dimension. We are just going to be looking at bonds of seven to 10 years of contractual maturity years remaining. Okay?

The uncertainty shocks, the way that we are going to define them are going to be months in which the VIX was in the top the side of its monthly distribution and we are going to run an non-parametric estimation of credit surfaces as a function of deliver at ratio considering different rating groups to control for some additional heterogeneity of this firm. So it's going to be a group like everything that is rated a minus or above, everything that is rated triple Bs, double Bs cetera. And for each of these rating groups, there are going to be two volatility regimes, high uncertainty, low uncertainty, and we are going to run a regression for each of these kind of like bins, okay? And we are going to feed these non-parametric function M that is going to depend on which rating group and which volatility regime we are looking at. But we have at least 9,000 observations for each of these regression. In fact for some we have many more like millions of observations.

Okay? Now following the empirical corporate finance, we are going to be measuring leverage in practice using what we are going to refer to as the empirical leverage ratio, which is just total debt divided by the value of the firm where we replace the book value of equity with the market value of equity. Now the book value, which debt is still going to be measured at book value, is equal to the market value at issuance but evolve independently of the subsequent grade conditions. So this is going to introduce some distortions in the measurement. So think about the picture I'm presenting here, which a

simulation using a log normal distribution, but the point is that right after the bond is issued there is a jump in volatility.

So what this is going to do is that it's going to reduce the market price of debt, but because we are measuring from balance sheet, it's going to still be book value. What is going to happen that instead of seeing the jump in the create surface from the blue, solid blue to the solid red lines, we are going to actually wind up with the dash red line which is hardware in the middle. So we should see the steepening from lower level ratios but we might not see it for higher ones. Okay, now let me show you the evidence.

This is for the triple B bucket. Arguably this is the picture that looks best for our purposes, but I'm going to show you for the other ones. But just to walk you through it, so we have the empirical labor ratio in the x-axis, optional adjusted press on the Y-axis, then the fitted curve for normal times and uncertainty shocks and we see that both moves up and it gets deeper kind of like point by point in the leverage distribution.

Now to be fully upfront, and this is the picture for the other rating groups, when you start walking down the grade rating and you start moving higher on the leverage ratio, you start seeing things that doesn't quite look like at the steepening that we described, but we think that the evidence broadly supports this view of the steepening of the credit surface. Okay, so let me walk you quickly through the model. The model is very parsimonious and it's actually very general and nested kind of like the Merton tradition with the Geanakoplos tradition in general equilibrium. So we think that these phenomena are going to be widespread in the models that people use to study this market. The economy is going to have two periods. In period zero agents trade financial assets and risky debt contracts. Each contract is described by what the amount that they promised in period one and also by the collateral that is backing the promise, and we assume that there is a risk-neutral measure that will price the collateral space off and the bonds that are backing by this collateral and we are going to denote the cumulative distribution function by big F. Now the distribution is going to pin down the expected value of the collateral going forward, which we can think about as the forward price of the collateral that we are just going to denote by E.

So first proposition in the paper is about this bond price function that we denote by pi, and it's just the expected value of the minimum payoff between the promise and the value of the collateral. And its classic in these models. One of the first characterizations is that you can write the pricing function as the difference between the promise and the integral or the integral of the CDF, which the upshot of that is that as you can see at the bottom of the slides is that the expected loss of any promise you can actually bag it out from just integrating the CDF. But what is nice about this pricing function is that has several properties, is continuous, is concave, is differentiable, it's also going to be like the identity up to a point when the contract is fully collateralized, then it's going to be strictly increasing in the region up until you promise the highest possible value of the collateral and then it's just totally flat. Okay?

Now what is interesting for the second set of results that I was describing at the beginning that we can invert prices to understand uncertainties is that the pricing function reveals all the information about the uncertainty. In fact reveals the full CDF of the distribution of collateral values that you can actually readily obtain by just using the expression for the pricing function there. And there is going to be a concept that we are going to use and is going to relate that our work to reliability theory, which is the equity value conditional on it being positive. Which is a natural object to study in this context.

So there are going to be three standard ratios or actually there are others, but let's look at these three that measure the amount of debt relative to the collateral value. We are going to call the first one the promise to value, which is just the promise normalized by the forward price of the collateral. The loan to value, which you're probably familiar if you have borrowed to buy a house, it's just the size of your loan relative to the value of the house, and the is also the asset to equity ratio that something is just referred to as leverage, which is related to the long to value by the expressions that I have there. Now the standard way of quoting bonds is in terms of the promised yield or the spread. And the spread is just the promised return above the risk-free rate and we can express it using the objects that we have laid out as the ratio of the promise to the bond price or the ratio of the promise to value to the loan to value.

And know that all these leverage ratios and the spreads are unchanged if we scale everything by a constant. So we scale the promise and we scale the value of the collateral. It's like you are adding one zero into all the numbers and nothing changes. So this is going to motivate our definition of the dispersion of the values of the collateral, which is the distribution of the normalized random variable, X, divided by the forward price. And we are going to denote this by this F super D.

Know that because F super D is unchanged, if we scale everything by a constant, we can multiply this by one plus R and we obtain the distribute the dispersion of returns to the value of the firm. So dispersion is going to be tightly related to the return distribution. So the credit surfaces and dispersion. So this is kind of like one of the key results. So with each level at ratio, we can define a different credit surface, which is the mapping from that level ratio into the spread. We can use the expressions that I have just laid out to relate the different layer arts ratio between themselves. And what these yields is a very sharp characterization of these credit surfaces, which is the first expression that is the loan-to-value credit surface is just this function that gives me the promise-to-value for each loan-to-value, this function y, divided by the loan-to-value. And for the promise-to-value surface is the opposite. It's just the promise-to-value divided by the function that gives me the loan-to-value for each promise-to-value? Now the credit surface is going to be entirely determined by the dispersion function FD, and what we think is actually very neat is that we can use now only information about this credit surfaces to fully recover dispersion distribution. So this is how you will go from bond prices or created spreads to back out what is the distribution of outcomes that is baked in the risk-neutral measure. Okay?

So now in the interest of time, I'm going to just give you a high-layer perspective of the first set of results. So because the credit surface is going to be determined by this ratio between a function and its argument, we are going to have a technical lemma that is going to say when you have a function H that is G of X over X, the more curvature that you have on G, one degree less you're going to have in H. So let me just unpack that. So if J is convex, H is increasing, if the third derivative of G is positive, then the second derivative of H is positive and we have slightly similar results for when you put the G function in the denominator.

With that, we can establish the first theorem that characterizes when the LTV-grade surface is convex, it's going to be convex whenever the density function is low-concave. And we actually thank ChatGPT for bringing this insights from statistics into our domain. Also when the value of equity condition on it being positive is convex. And it turns out that these two conditions are going to imply this technical condition here that is basically saying that the density function, if it's increasing, then you are going to have that term is positive. So for all kind of new mortgages or sorry, new contracts that are promising that are on the left side of your bear curve in terms of expected value, so you are promising less than the value of your house say, then this relationship is going to be convex. Things start getting a little bit more

complicated when the promise gets too large or the credit is underwater. But for the function that have this property, we can actually establish that the LTV-credit surface is going to be convex throughout.

Then we go on and look at what are the distributions that satisfy these properties. Most of the distributions that you're familiar with are going to satisfy one or the other. Exponential function, normal function, power law, uniform, gamma, Weibull, you name it.

In the paper, we also provide similar results for the PTV-credit surface, but we just want to highlight the fact that the LTV-credit surface is convex under milder assumptions that the other two surfaces using the other layer that ratios. And that is because of the relationship between these ratios that actually you can establish that it's convex and you can use that the composition of a convex and increasing function with a convex function is going to be convex. These are here some numerical simulations. I want to draw your attention to panel B. This is you really squint close to zero. You can see that there is a failure of convexity, but it's really hard to appreciate in practice. Okay?

Okay. So last to think about, let me describe our results about uncertainty shocks and create surfaces. With our shock characterization, we can show that the change in the spread as a function of the LTV is just the change in the promise to value divided by the common loan to value. And we can use our lemma that relates the curvature and the increasing properties of a function with a function characterized by a function and the argument in the denominator, and that gives rise to the following theorem. So the first one is just to recast what is the well-known result that if you have an in preserving spread in terms of these distributions, you are going to get that the spreads open. So spreads are going to be higher.

And the second part is a more technical result that then we are going to try to flesh out. Says that when the dispersion composed with this PTV function is smaller in the hazard rate order than the alternative during normal times, then we are going to have that the difference of the Ys is going to have all the nice properties and in particular is going to be convex, which means that the ratio with L is going to be increasing, which is the steepening result that we are trying to describe. And here is a way to try to characterize what this kind of condition implies for the distribution function without the [inaudible 00:52:55] to compose it with the Y function and what conditions you are going to see the steepening result.

So this K function is describing how much the promise needs to grow when uncertainty changes to maintain the same long two value. And there are two things that the lender is going to be worried about. One is that there could be more mass that is moving to the left, that is going to make the default more likely and more onerous to him. But on the other hand as to offset that the borrower is going to have to increase the promise. Now if the debt fully repays, which is the probability in the denominator of the K function, then the lender is going to get the upside. So the promise need to adjust in order to keep the lender happy. So you're going to have to trade off these two forces. Okay? Now when this relationship is convex, we have that this mapping Y is convex, which is going to give us the steepening result when everything is differentiable.

And now what is interesting is that for a proportional mean preserving spread that basically everything is blowing up by this V, which is the same transformation you do for a normal distribution from the standard normal. When you have then you have this K function is going to be related to the value of equity and this K function and the value of equity is going to be convex for different families of distributions like normal power, law and uniform. And for the other distribution like the non-normal, we can understand directly whether this condition of Lemma two is going to be satisfied. And actually we

show that that's the case. And it's also the case when you lower the power coefficient of a power law distribution.

These are a few simulations for the different distribution families just to show that numerically we see the steepening result. What is interesting here is that there is this gray line that is plotting the difference, but when we move into the promise to value grade surfaces, which we have similar results in the paper and I didn't get to show the change in the spreads is actually half shape. So you always get the steepening at the beginning, but it always flattens at the end.

With that, let me conclude. So we present some evidence that bond grade surfaces not only moves up but also steepen with economic uncertainty. We present a simple model of collateral and equilibrium to explore the general shape of the credit surface along the leverage dimension, our result describe a new steepening channel through which uncertainty shocks affect the supply of credit and the macroeconomy. And our results suggest that macroeconomic policy could be more effective by targeting the entire credit surface rather than that the riskless rate. And in practice financial contracts specify multiple credit terms spanning other dimensions of the credit surface. There is the rating, there are covenants, and our analysis we think provide a nice jump off point for this agenda to move forward. Thank you very much.

Leland Farmer:

All right, thank you very much for inviting me to discuss this really interesting paper. I do just want to provide a brief disclaimer up top, which is that I'm not a finance theorist and I'm an empirical macroeconomist and more of a time series econometrician training. So I'm going to focus my discussion on the thing I know the best, which is the data and my thoughts about the data, and then also how to map this type of framework and type of modeling approach to the data. So I don't actually think I need to spend too much time in the introduction because David did a great job of explaining the contribution of the paper himself. But just as a quick recap at the big picture of the paper is that the paper proposes this idea of a credit surface, not the first one to do so, but to characterize it in more detail than maybe other work is previously done.

Thinking specifically about how credit spreads vary across different levels of leverage, not just focusing on an average number, and advocating this as a way to summarize credit conditions and thinking about the mapping between the surface and uncertainty, instead of just looking at a single average spread. So there's a very nice theory in the paper that defines and characterizes credit services in a fairly general and easy to understand environment. Again, a lot of the paper is sort of focused on describing this one-to-one mapping between an underlying uncertainty and the shape of the credit surface, a particular how mean preserving spreads in the distribution of collateral affect the level and the slope of the surface. And then some evidence on these credit surfaces in the corporate bond data across different ratings, leverage levels, and then these high and low uncertainty regime. So I'm going to have three main comments and I'll get into those in more detail. Those are going to be the focus of my discussion.

One is going to be this idea of thinking of the credit surface as an uncertainty object and really digging into what we mean when we talk about uncertainty specifically. The second will be a little bit more technical in terms of details of just measurement and testing this rising and steepening in the data in some ways I think can be done fairly easily. And then a couple of comments just perhaps on the surface puzzling results about the lower grade investment bonds, which I think are actually not that puzzling and can maybe be explained a little bit more easily within the context of the paper. So let me just skip over

this and go straight to my comments. So the first major comment that I have is really digging into this notion of what do we mean when we talk about an uncertainty shock.

So in the model it's very clear, it's very clean, an uncertainty shock is just a mean preserving spread in the distribution of the collateral value, which was X in the notation in the paper. Now, in the data, the way that they tackle this is they focus on high VIX months. So specifically looking at when the VIX is in its top decile above its 90th percentile, and these are sort of treated as high uncertainty periods, right? Uncertainty, shock periods. But we know that the VIX captures a lot of things. It doesn't just capture increases in expected volatility or uncertainty, it captures risk premia, hedging demand, liquidity, a bunch of other things. And so I do think there's a little bit of this tension here in terms of the motivation, which that the key interpretation of the paper is the steepening of the credit surface is sort of one-to-one with this notion of an increase in uncertainty or an uncertainty shock.

But when we look at hi VIX periods, it's sort of not clear that that's really what we're measuring in the data, right? Because an increase in VIX sort of mixing changes and increases in expected volatility with pricing of risk.

And so I have a couple of, I think fairly straightforward suggestions here, which is that we've come a long way since Nick Bloom's papers talking about uncertainty shocks and looking at VIX. And we've developed a lot of ways to measure uncertainty in the data. So one of my favorite ones is this paper by Kyle Jurado, Sydney Ludvigson, and Serena Ng from AER in 2015, where they provide these measures of macro and financial uncertainty. You can just download them from their website. And I think those sort of maybe more directly capture the notion of what the authors mean by an uncertainty shock.

But if you want to stay with the VIX, I mean, I understand there's kind of historical reasons for using the VIX and has been used a lot in this literature. We're thinking about uncertainty to at least kind of think a little bit more or talk a little bit more about the relationship between high VIX and mean preserving spreads in collateral values. So just a quick picture, I just downloaded the data and plotted it. It's pretty simple. So the blue line is the VIX, the red line is this measure of financial uncertainty, and the yellow line is this measure of macro uncertainty. If you sort of just eyeball the picture for a minute, they do look very highly correlated and they are, but there are kind of a few key episodes where they tend to deviate from each other. So if you look at the mid to late '90s, you'll notice that this macro uncertainty index is relatively low relative to say the value of the VIX. There's other episodes where that's the case with financial uncertainty in the VIX as well.

So just to kind of summarize that in a couple of headline numbers, if you look at correlations, VIX and financial uncertainty are actually fairly highly correlated. Something like 0.8 macro. Uncertainty in VIX are maybe a little less, around 0.6, but I think what matters more for the point being made in the paper is the tail behavior of these things is actually pretty different. So when you look at high VIX episodes, a high VIX episode, if you define that as the VIX being above its 90th percentile,, and then you say define that as being a period where financial uncertainty is above its 90th percentile, those actually only coincide in less than 50% of the sample. And it's even lower if you look at macro uncertainty.

So again, it's sort of not clear depending on how you measure uncertainty, that uncertainty and high VIX really mean the same thing, right? And high VIX episodes can capture a lot of things. They can definitely capture higher ex ante uncertainty, but they also capture things like shifts in risk premia and they definitely don't correspond to pure mean preserving spreads in collateral at least all of the time. And so I think kind of a cheap thing to do or an easy thing that might just really strengthen the motivating evidence for the theory is just instead of using VIX, use macro or financial uncertainty and just sort of

establish that these relationships, the steepening and this increase in credit surfaces is still there and I sort of expect it to be, but I think it would make the point a little bit more cleanly. One final comment I have about that is just again, the theory is actually really complete in terms of its mapping between uncertainty and credit surfaces. There's nothing special about high uncertainty, it's just there's this one-to-one relationship between uncertainty and credit surfaces.

And so there's actually a lot of information in calmer times as well. You could just as easily ask, if we look at particularly low uncertainty months, does the credit surface flatten and go down? I think that's just a symmetric implication of the theory. And so one way you could do this is just looking at a little bit more of a continuous relationship between whatever your favorite measure of uncertainty is and the credit surface. And those are very stark implications of the theory and something I think the authors could do pretty quickly. The final comment I'll mention, I don't have time to dive into this very deeply, is just there is sort of this concern about when you think about uncertainty shocks or high uncertainty periods that you are mixing first and second moments as well because we might think that high uncertainty episodes are also maybe crisis episodes where there's a lot of left tail risk and actually there's kind of a left shift in the mean as well. So I just sort of encourage the authors to think about that a little bit.

My second point is a bit more on the econometric side, but I'll try and keep it relatively simple and digestible. The visual message of the pictures is actually very striking and I think very effective, which is that you look at high VIX periods, the credit surface is steeper and higher and that's exactly what the theory predicts. And that's especially true for these higher grade investment bonds. So the BB and above double B and above one way I think that this point could be made maybe just in a more concise way or at least to report as kind of a headline number. It would be nice just to be able to report maybe one or two numbers that summarize this steepening and quantify a little bit more easily. So I understand the desire to use the non-parametric regression.

I actually think it's really nice because you want to capture the convexity. You want to be kind of agnostic about what the shape of this thing is, but if you just run a simple interaction term regression, we can just capture that really easily. So if I just take the variables from the data that the paper uses, option adjusted spreads on the left, leverage ratios on the right empirical leverage ratios on the right, you can just run a simple interaction term regression where you interact leverage, and this indicator for a high uncertainty period whether that's high VIX or something else. And then that interaction term is just going to capture directly this idea of steepening. And then we just understand that beta three is telling us something about the degree of steepening across these different grades of bonds and I can just report one number to kind of summarize that in a very digestible way. If you don't like the slope of the regression, you could also think about something, the interquartile difference and how that changes across these high and low uncertainty periods as well.

One other kind of minor point I'll just make here is about being a little bit more formal about the econometrics. Again, like I said, I'm a time series econometrician by training, so I feel like I'm obligated to make these kinds of comments, which is just that the services are reported without any notion of standard errors. I do think it's sort of important, especially when you're running nonparametric regressions, there's a lot of inherent sampling variabilities in these things even with a lot of data, these things need a lot of data to be precisely identified. And so just kind of providing some formal notion of how significant this steepening really is in a statisticalized sense is kind of important. In the regression I had on the previous slide, that's really easy. That's just testing the statistical significance of beta three and an interaction regression. That's really easy to do, but if you kind of want to stick with the

nonparametric representation, there are really easy to implement bootstrap methods or permutation tests to do the same thing.

And then just one extremely minor point here. In this nonparametric regression literature, I've worked a lot with these myself. Bandwidth choice is something that's really, really important. The authors kind of just pick a number and go with it, and we have a lot of sophisticated methods for choosing bandwidth in nonparametric regressions, cross-validation type methods. So I think it's kind of an easy use a package to just pick the bandwidth automatically instead of choosing a random number. And that would go a long way to do I think strengthening those results as well.

My final point that I want to make, and I'll spend my last few minutes discussing is kind of the picture of David was very transparent about which is the seeming breakdown, at least visually of this pattern in the lower grade investment bonds relative to the higher grade investment bonds. So if you looked at the triple B bonds, that was the first picture I think you showed. There's this very nice increase in the credit surface in high VIX periods, very sharp convexity, very sharp steepening. But if you look at the kind of lower grade, the triple C for example, this is the picture that I've reproduced here. You do get this kind of flattening and concavity in the upper region and like I said, they're very transparent about that and it's a first pass of a theory. It's not going to capture everything. But I do just have kind of a simple question, which is just to try and think a little bit about why they deviate from the benchmark of increasing convex spreads. And actually, I mean he kind of hinted at this during his presentation, but I'll just encourage to be a bit more direct about it maybe in the presentation in the paper. I think there's one obvious explanation or maybe two obvious explanations, but two I'll focus on here. One is just about covenants and renegotiation.

So if we think about in the model, it's a very simple model. It's again designed to capture this one dimension in terms of the relationship between spreads and leverage specifically as we talked about, credit services are a function of many aspects or many characteristics of the bonds, including covenants were mentioned directly. So in the theory as it is, of course there's this very nice relationship, higher LTV, smoothly, higher expected losses that gives us this convexity in the surface under fairly mild assumptions. But we know in reality when we're looking at lower grade investment bonds, there's a lot of covenants, tight covenants, strong credit or control in these cases there's frequent renegotiation of contract terms here, exchange offers restructurings. And effectively, once you reach a certain point in the tail of the distribution, there's essentially an expected cap on the recovery, which is just at that point a restructuring of the firm is expected. And we sort of understand that no matter how much more we promise that there's sort of just going to be a cap and that could sort of lead in the data to this flattening of the credit surface that we observe for these say triple C bonds, which is that things are just getting really compressed because the risk is sort of just flattening out in the right tail of these things.

The second thing that I'll mention, which again Dave didn't have too much time to get into in detail, but is an important point in discussion in the paper, it's just how leverage is measured. And again, this is sort of a limitation of the data, but I do have a couple of quick suggestions, which is that in theory it's very clear know LTV is sort of the clearest measure in terms of this mapping between credit surfaces and convexity.

And uncertainty also discusses promise to value. And this other measure of leverage in the data, this notion of empirical leverage is used which uses the book value of debt. This is an approximation and it's technically assets, book assets minus book equity, but roughly speaking it's something like this and they sort of explain this mechanism, which makes a lot of sense, which is that of course in high uncertainty

states or when you're looking at lower grade investment bonds, well what's going to happen in a crisis? The equity value of the firm is going to collapse. And so essentially because book debt is sort of adjusting more slowly, these empirical leverage ratios are just going to mechanically compress at the top of the leverage distribution. So a lot of firms that have very distinct loan to value ratios, if you could measure those properly, are just going to cluster at empirical leverage ratios that are very close to one.

And so that can kind of flatten or mute some of the effects of the steepening of the credit surface when you look at high uncertainty versus low uncertainty periods. And there's a bit of discussion of this in the paper. So my last point that I'll make because almost out of time, it's just some concrete suggestions here, which is I actually think you can kind of put a positive spin on this in the paper, which is just that the theory is designed to be very elegant and very simple and it's not a failure of the theory per se to have this flattening in the CCC case. It's really just informative I think, of the presence of other aspects of these debt contracts like covenants and restructuring. A couple of quick simple suggestions. One again, this might be outside the scope of the paper, maybe this is for the next paper, but to just include some kind of toy recovery cap or renegotiation option there and in some simulations like they do with other aspects of the model, get at how this affects measurement of the credit surface.

And then just a couple of exercises I think they could do in the data that may or may not be feasible, I don't know. But one, to test this a bit more directly, you could sort of split these high-yield or low-grade investment like CCC bonds by covenant tightness. So if you have for example, FISD data, they have measures of different covenants across these bonds and you could sort of directly test the degree to which it's these covenants and restructuring concerns that are leading to the flattening of the credit surface. You could also do something like use kind of an instrument-type approach where instead of using contemporaneous empirical leverage, you could use something like lagged empirical leverage, maybe like lagged a year where you think that if I'm getting kind of the pre-crisis or pre-high uncertainty period, empirical leverage measure, maybe that's actually a better measure or a better current measure of current market loan-to-value ratio than something like contemporaneous empirical leverage. And maybe that helps reduce some of the measurement errors and just sort of exploring a little bit the degree to which these two issues are sort of mattering for what they find.

So I'll end there. I'm sort of out of time. I'll just conclude by saying I think it's a great paper. I think it's a really elegant and nice theory and I think with just a couple of small tweaks in terms of these empirics, it could actually just really strengthen the contribution of the paper paper even further. And I look forward to seeing what they do next. So thank you very much for your time.

Joe Haubrich:

Before we take comments from the floor, I'll maybe give David a minute or two to respond to the discussant. Thank

David Rappoport:

Thanks for the great discussion. I mean there are clearly gains from trade here. We are more theorists and we don't do great empirical work, so we really appreciate the perspective.

So I like the proposal of thinking about other volatility and uncertainty measures. I am sympathetic to the view of keeping the regression analysis more simple and thinking about regression with interactions is probably an interesting avenue to explore. I do want to say that one thing that I am personally very excited about this nonparametric estimation is that for free, it gives me the estimation of the derivative

of the function, which is something that I need as an input in order to recover the uncertainty from the data. So the non-parametric has some additional potential, so it might stay around for a while.

And I guess the last thing I want to react to is I also appreciate a lot the comments about thinking harder about the evidence for the lowest rated firms. A couple of comments there. One is that for those, in that part of the distribution, we have the least amount of observations. So starting to cut the data thinner might run into problems. So that's one problem. You mentioned thinking about that recovery cap, the model is actually so flexible that you can change the distribution of collateral values and impose that it actually has a finite upper support and nothing really is going to change. I think part of what I think makes the analysis challenging when we start looking at the riskiest firms is that the model assumes that the debt how is priced at each one, but the model can also be thought as given that you have a contract that has already been issued with a very fragile balance sheet, how lenders are going to actually price that debt. It's just that is kind of like a little outside the scope of the model because in the model, you're never going to make a loan for a promise that, I mean, you are never going to take too seriously a promise that is promising more than any potential value of the firm.

You're going to just going to say, look, effectively you are going to promise me the same effective payoffs as the promise that is promising, exactly the maximum value of the collateral. So all the model what can say there is that all those spreads are just going to be flat as the promise keeps growing and growing. But in actuality what happened is that when the firm balance deteriorates exposed, you might wind up in a situation where you're holding the debt of a firm that you might have not been willing to issue. So there is a bit more to think about that, but just in terms of thinking about the recovery cap, the model is flexible enough to incorporate that with that much trouble. Yeah, thank you so much.

Joe Haubrich:

Thank you. We will now take any comments from the floor.

Speaker 6:

I have an alternative suggestion to Leland's way of dealing with the triple C problem. On the covenants issue, these are bonds. Bonds do have covenants, but they're not the kind of covenants that's going to give the lender any control. Okay? And it's not really going to have very much effect for the value of the firm or the value of the collateral.

However, if you talk to somebody from the rating agencies, they say if something falls into the triple C, double C, single C range, we think it's going to default, we just don't know when it's going to default. And so what that means is things that are driving value is going to be the recovery, as you mentioned. But again, these are bonds. These are typically junior to the loans and to some privately issued bonds such as those taken by insurance companies. And so if you look across the firms, what's really going to be driving things is details of the debt structure and that's going to be kind of unrelated to what's going on in the model. And so what that means is there's a heck of a lot more noise in terms of what's really driving things and it's just going to be much more difficult to recover curvature or much of anything. Okay. So it's a slightly simpler story. You don't have to get into FISD covenant things. You're in a maze of twisty passages if you do that, but it's probably true.

David Rappoport:

Thanks.

Speaker 7:

It's very nice. David, I'm wondering, so in the data, so it could be the market power driving the spread. So I'm just wondering how the model so far competitive model, am I right to say? So then how you think about, okay, maybe they make profit, they're driving up the spread because of the market power and also in the corporate bond market. So it is the OTC, so there's a search friction, they meet against each other, it can driving the dispersion of the spread look like a credit service. So how can we control for this kind of situation in the model and also in the data?

David Rappoport:

Sorry, the second part of your question.

Speaker 7:

So how do you think about, for example, the search friction BR spread the liquidity in the bond market that might map into, although look like a credit service, but so far the model doesn't seem to be handled this kind of additional friction that we also see in the data.

David Rappoport:

Want to collect more questions? Should I address? Yeah, so thanks for the question and thanks Mark. Also for the perspective on the CCC category. Yeah. Yeah. You're offering me an easier way out in some sense. I appreciate it. So in terms of market power, I would think that that might be more pervasive In primary markets. We are actually drawing evidence from secondary markets, meaning these are the prices at which these bonds are traded. In fact, it's not even that. These are actually the quotes that are presented by [inaudible 01:19:55] in order to construct their index. So it's not exactly the prices at which these bonds are transacted, but this is the quotes that inform the pricing of these indices. So that is actually what we are looking at.

In terms of self search frictions, I am personally sympathetic of that view, but I think here the scale of the magnitude of the difference of the spread just dwarfs the potential size of the VEDA spreads. You will think that you have maybe hundreds of basis points in terms of difference in VEDA spreads. And what we are seeing here for the riskier firms is the order of magnitude of thousands of basis points in terms of changes of spreads in periods of high and low uncertainty. So I think maybe the implicit assumption is that we tend to think that these things are not constant across the different uncertainty regimes, but the variation is not going to drive. It's hard to think that they can drive the effects in prices that we see.

Joe Haubrich:

Anything else? Well then I'd like to take the chairman's prerogative. And David near the end, you mentioned that one possible use for these curves would be in terms of policy, but I was wondering if you've got a whole curve moving around exactly. Is policy like moving a fed funds rate going to, how would you react to a movement along the entire curve?

David Rappoport:

So in the financial stability group. So I think my answer is going to be tainted by that perspective, but if you think about the response to the COVID pandemic, I think part of what, in my view, part of what make those responses successful is that the monetary authority not just intervene in terms of risk-free rate, but it also went out and bought some credit risk. So in the facilities for the corporate credit programs, the primary and secondary market facilities there, just the announcement has a huge effect as a backstop. And that might have reshaped the surface as we call it, and that could have potentially effect.

Now there are other people that are thinking in terms of thinking about financial conditions to conduct traditional monetary policy operation through the business cycle. You have the work by Simsek and Caballero are thinking about that not just from spreads but for financial conditions more broadly. And other people have also thought about those issues. And the question is, I think I just want to point to the question more than just to say how you will conduct policy, but how you should take the current financial conditions into account when you set the monetary policy rate, for example.

Joe Haubrich:

Thanks. Any last questions? Well then I want to thank Gorkhem, David.

Speaker 9:

I had like to ask a question of the first speaker. When you were talking about information and this interface between liquidity and information, you have a Markovian assumption initially and that puts an extreme constraint on how information diffuses. Essentially, it doesn't. Every stage is a new state. So do you have any plans to relax that? Because most of the information structures that I've seen of information theorists has to do with the dynamics of the diffusion of information.

Gorkem Bostanci:

Does this work? Yeah. Okay. Thank you for the question. You're right. Right now we allow, and I presented a simplified version. The full version of the model allows for persistence in the information that cannot be learned that we can allow. But I think your question refers to more that the persistence of information that can be learned and what we learned today can be helpful in future periods. We could not find a way to preserve tractability by allowing the persistent information to be there. As soon as it is there. I have to take into account how the information acquired today is going to influence future prices, which is another reason why I might want to prefer one stock over the other. It's in the plans. It's in the plans in the sense that maybe we figure it out and if we figure it out we can include it. But right now we don't have a clear idea of how we can incorporate it and yet maintain the tractability of the model. But I completely agree and it is important.

Joe Haubrich:

All right. Thank you Gorkham, David, and Leland.