

FINANCIAL INNOVATION, COLLATERAL AND INVESTMENT¹

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If you think about macroeconomics and the tradition of macroeconomics, it is all about the interest rate: you open the newspapers and every day they are speculating of whether the Federal Reserve is going to raise the interest rate in September or is Janet Yellen³ going to wait? Is she going to do it earlier? If anything goes wrong, you are supposed to lower the interest rate. It is all about interest rates. The idea is that if demand is wanting (not enough demand), you lower the interest rate; if there is too much demand, you raise the interest rate.

The interest rate is the controlling variable that the Federal Reserve and the Central Banks pay attention to. Maybe it is not the short interest rate. Lately we have come to think about long interest rates and quantitative easing and maybe the interest rates do not always work, because they reach a zero lower-bound, but basically, it is all about interest rates.

But if you think entirely about interest rates, what does it mean for credit to be tight? That is a very common expression, businesspeople use it all the time: credit is tight. Does that mean that the interest rate is too high? No, I don't think it means the interest rate is too high; it means that people who want to get loans and are willing to pay the interest, cannot get them because the lenders are afraid they are going to default.

1 Transcription of John Geanakoplos' conference at *30as Jornadas Anuales de Economía* organized by Banco Central del Uruguay, 3-4 August 2015, Montevideo.

2 American economist and the current James Tobin professor of Economics at Yale University. He received his B.A. in Mathematics from Yale University and his M.A. in Mathematics and PhD in Economics from Harvard University. In words of Ana Fostel: "John's academic contribution is vast and in many areas: psychological game theory, general theory of incomplete markets, social security, general equilibrium theory with money. Actually, he is one of the precursors of incomplete markets general theory and his results together with Polemarchakis (1982) on generic inefficiency have huge macroprudential policy implications today. More recently, John has modeled collateral and leverage within general equilibrium theory. He has developed the theoretical model in 1997 and the leverage cycle theory was developed in 2003. In my opinion, all conceptual issues needed for a better understanding of 2008 crisis were already in that paper, which I read being his pupil."

3 Chair of the Board of Governors of the Federal Reserve System since February 2014.

So default is the key to the credit markets, but it is almost entirely missing in most of macroeconomic theory, so one of the previous Presidents of the Central Bank of Uruguay yesterday⁴ suggested that Economics should be about trust, that we have to pay attention to trust, so default is about trust or the lack of trust.

If lenders are worried about default and there is a lack of trust, they are probably going to ask for collateral. The bigger the collateral, the safer the lenders are going to feel and the lower the interest rate will be. They suggest keeping track of a ratio. How much collateral per dollar promised or how much promises per dollar of collateral. That is what leverage is: the value of the loan divided by the price of the collateral. Leverage is very important; if you negotiate a loan on your house, you have to figure out what interest rate you are going to pay, but also how much leverage, how much can you borrow. Suppose it is a hundred thousand dollar house. Can you borrow 80 thousand, can you borrow 95 thousand? That ratio is leverage and I think it is at least as important a variable as the interest rate. But how then in theory can one equation “supply equals demand” determine two variables: interest and leverage? That is the reason why macroeconomists do not talk so much about leverage, because it is hard to figure out what are the equations that lead to endogenous leverage and endogenous interest rates.

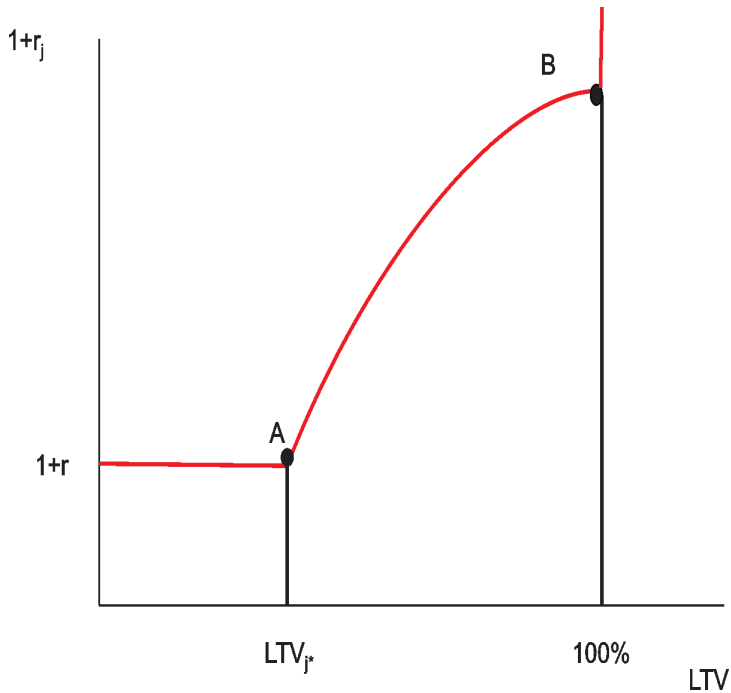
If you think about endogenous leverage, you are forced to think about a menu of possible interest rates, and that is what the credit surface is. In Geanakoplos (1997) I introduced the concept of *credit surface*: the equilibrium relationship between LTV_j and $1 + r_j$. The Credit Surface is defined as the interest rate lenders require as a function of leverage. The higher the leverage, the riskier the loan, and therefore the higher the interest rate lenders will require to make a loan. So, it describes the relationship between leverage and the interest rate. The more leverage that you ask for, the more scared the lender is going to be and the higher the interest rate the lender is going to ask for.

Borrowers can choose any contract on the Credit Surface provided they put up the corresponding required collateral. In the Arrow-Debreu budget set, borrowers face a flat Credit surface.

4 Ricardo Pascale, in the “30 years of JAE” conference during the 30th Jornadas Anuales de Economía, 2015.

So you could have a little picture like this:

Graph 1



On the horizontal axis you have the loan-to-value and you see that it goes up to a 100% on the right, and on the vertical axis you have the interest rate. So, if the collateral is so big that the loan-to-value is so small, the lenders will feel very safe and you can pay the riskless rate of interest. So you can borrow more and more as long as the lenders feel safe and can pay the same interest rate. But the moment the lenders start to worry that the collateral is not enough to cover the loan, the interest rate is going to start to go up, so you see: the point A is the maximum loan that you can get at the riskless interest rate. If you try to borrow more on the same collateral you pay a higher interest rate.

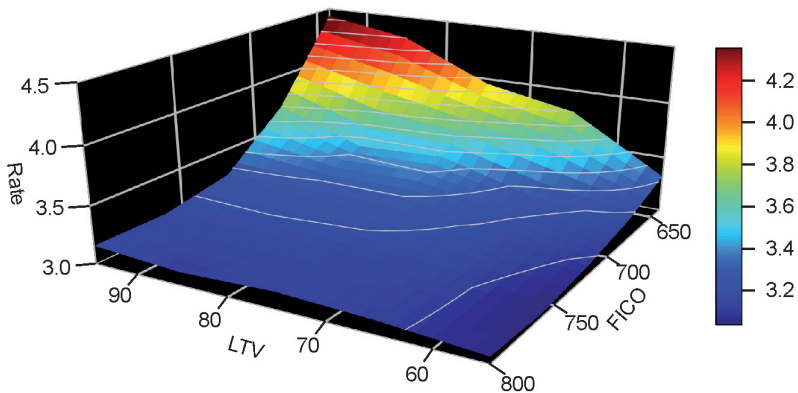
In the standard theory, the Arrow-Debreu theory, and any other basic theory, the interest rate is the interest rate, and borrowers decide how much to borrow at the given interest rate. They don't worry that if they try to borrow more they are going to have to pay a higher interest rate, so that is the idea of credit surface.

Ana (Fostel) and I have proved (forthcoming) a general theory of that, that for certain kinds of collateral, the credit surface will rise so steeply that borrowers will always choose to borrow the point A on the credit surface, the maximum LTV at which there is no default, without any possibility of defaulting. That is for a special kind of collateral with two states of nature. I will not go into the details, but for a certain kind of collateral you can see very easily how much leverage there will be, up to the point where they have to worry about default. So, you can see that if the collateral becomes safer, it is not as volatile, so in the worst possible state it will not go down as much. That means you can make a bigger promise and still always keep that promise, so A will move to the right when the collateral gets safer and so the amount the people can borrow is going to depend on how safe the collateral is. That is the key idea: the leverage cycle reflects the fact that how much leverage people can take out depends on how safe the lenders think the asset is (backing the loans).

Though macroeconomists have not really made great sense of the credit surface, real world businesspeople do all the time. In practice, interest rates depend on many credit-quality indicators. If you go to any bank and try to take out a loan on a house, they will ask you how much you want to borrow on the house. If you want to borrow more they are going to charge you a higher interest rate. Of course, they are more subtle than that, they will find out your credit rating, because that is a sign of your quality as a borrower. If you have a bad credit rating they will charge you a higher interest rate, so there are many indicators of how reliable a borrower you are, and the real world pays attention to those indicators and then adjusts the interest rate accordingly. The interest rate depends on how good a borrower you are. Credit quality can be measured directly in terms of ratings for corporations or FICO score for individual borrowers. In addition one might expect income or wealth to be important variables in determining the loan rate.

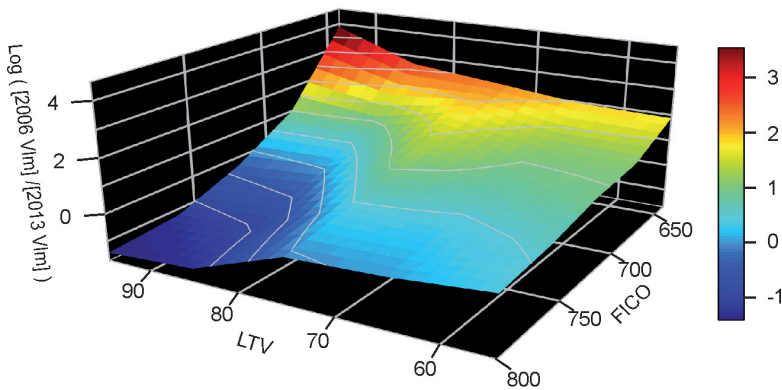
I decided to try to estimate the credit surface. The data base include all the loans given by the American agencies, Fannie Mae and Freddie Mac. They are the ones created by the government to help people get mortgage loans, so there are millions upon millions of these loans and I wrote down every single loan, what the FICO score, and the credit score. And then I wrote down the rate that people were charged, what was the mortgage rate, and I simply drew a graph, throughout the points. Please look at Graph 2. You can see that with very high FICO (800) and very small borrowing (under 60 LTV) you are on the bottom corner. You can get an interest rate in 2013 that was barely over 3%. But if your FICO goes down and the loan-to-value goes up, the interest rate they charge goes up, goes up to 4.5%. Now, these are the most reliable people in the United States. To qualify for a loan like this you have to meet all sorts of specific criteria. So these are the best borrowers in America, and you see that even among the best borrowers there is a tremendous increase in the interest rate depending on what your FICO is and what the LTV is.

Graph 2



For subprime loans, the interest rate would have been much higher and the credit surface would have been much steeper. I also have tried to get that data but it was not so reliable. Instead, you can compare 2013 to 2007 and 2006, the boom years, and take the ratio of 2006 to 2013. You see that in the back corner there is this huge number of loans, with low FICO and high LTV, given in 2006; that is the ratio of loans in 2006 to 2013. See graph 3.

Graph 3

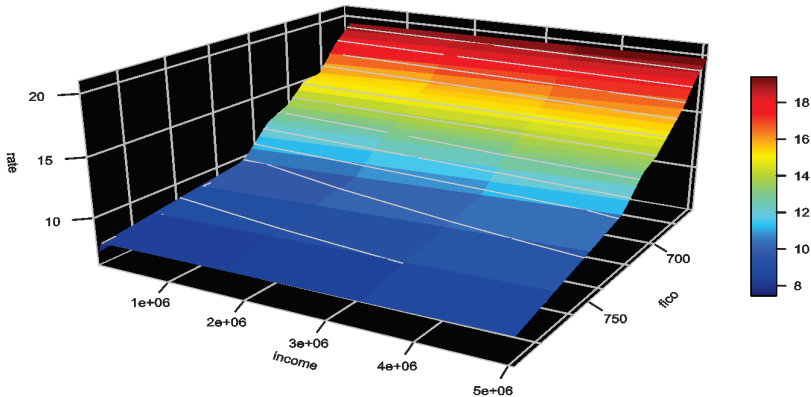


During the boom years, they give lots of loans with high leverage and low FICO, and today if you want to get a loan with the ratio of 2006-2013 you can still get a high LTV loan in America, but you have to have a perfect FICO score. Basically what has happened now in the United States, is that low FICO borrowers are completely closed out of the market, they cannot borrow at all, and low is seven hundred or below (my credit score is 700 or 730). Those kinds of borrowers are cut out of the market now.

I did another thing to get an idea of the credit score right now. There is a famous online company now called “Lending Club”. If you want to borrow money, you go online, you tell the loan-to-value you want, your FICO score... these are actually uncollateralized, not the loan-to-value...

your income, your wealth, and you send it in over the Internet. They check that what you are saying is right, and then people who want to lend you on the Internet can choose an interest rate and offer you a loan. This is how these loans are clearing now. Lending Club does 200 billion dollars of loans a year now. It has become a gigantic business. They also keep all the data on the Internet, it is public data. The data I used to construct graphs 4 to 9 was composed of the FICO score and the income - which turned out not to matter much - and then in the vertical axis is the interest rate.

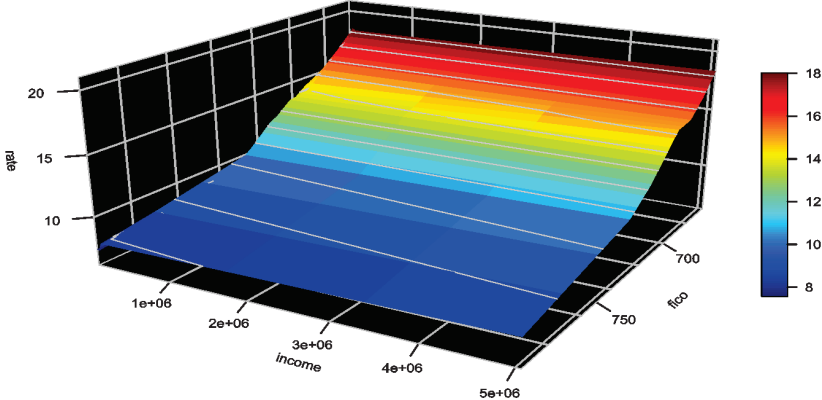
Graph 4



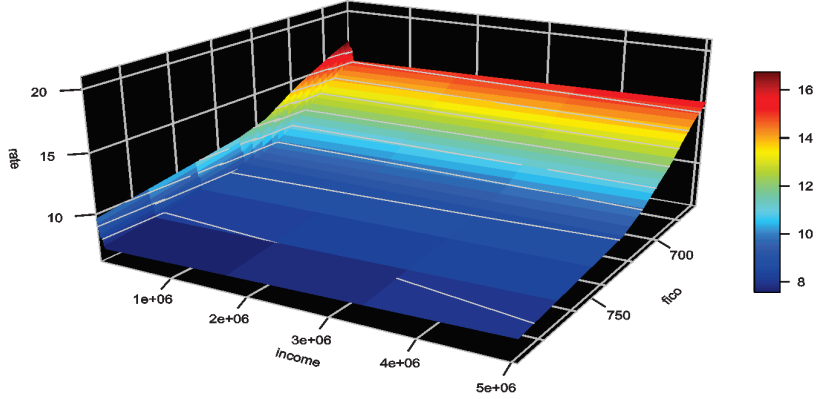
In graph 4 you see that for high FICO loans, the interest rate is 5 or 6%, but if you have a FICO below 700 (this is for 2012), the interest rate is almost 20%. It gets lower by the end of 2012 and still lower in 2013 - the first half, second half of 2013, 2014. That is the last data I could get, lower still.

It is clear that in the United States credit conditions are getting easier, the credit surface is becoming flatter because you can get a low FICO person get a loan on the Internet for a smaller interest rate than they could before.

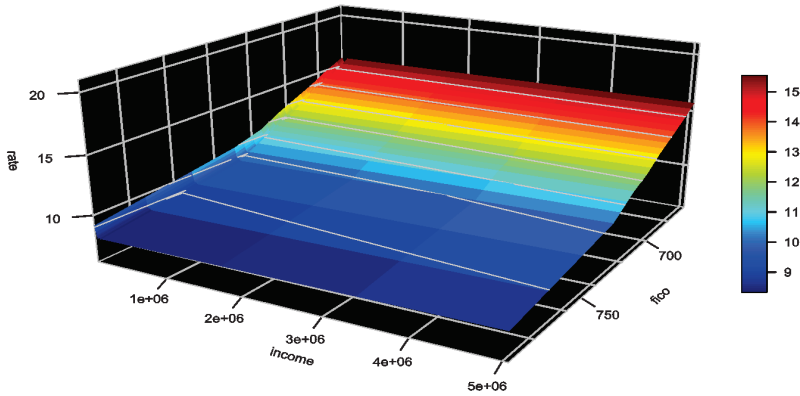
Graph 5



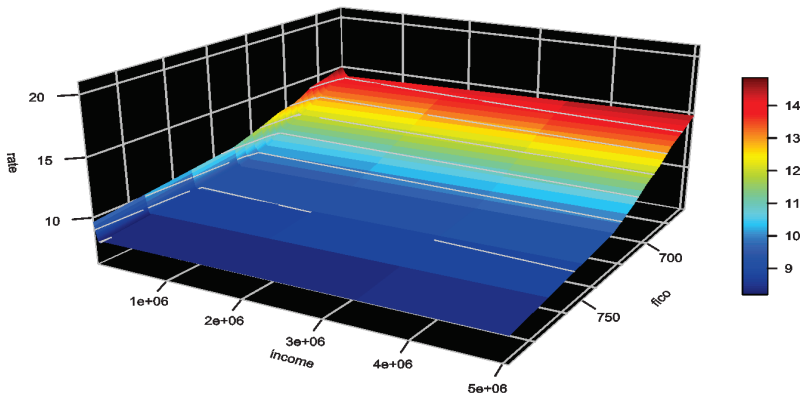
Graph 6



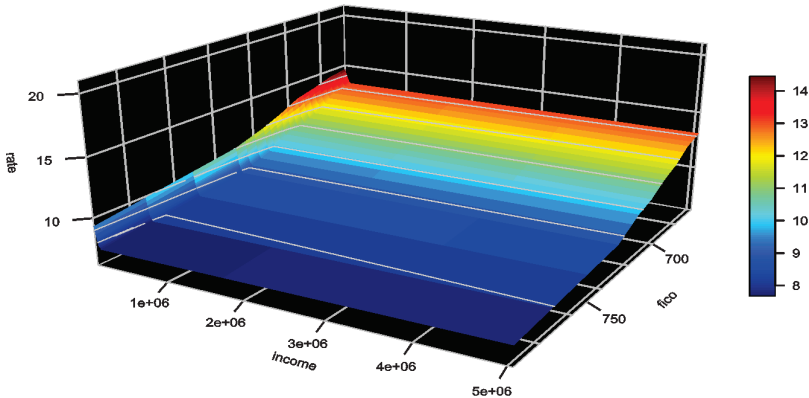
Graph 7



Graph 8



Graph 9



In sum, the key to credit conditions, I am trying to say to central bankers, is not the level of the riskless interest rate way down there, it is how steep the credit surface is, how fast the interest rate rises as you become risky. The most interesting borrowers, the people who are doing something, are doing something risky, and so they are going to pay a higher interest rate than the riskless interest rate. If you just follow the riskless interest rate you miss what is going on in the economy, it is the businesspeople who are taking risks, and lenders therefore charge a higher interest rate; that is where all the action is and that is the thing we should be keeping track of.

My recommendation is that given that the central bankers could have all the data I would recommend that central banks map out the credit surface for important collateral, and publish the surface quarterly. They should be producing credit surfaces that the rest of us can see. That would help the business community, -would increase competition by the way-, to know what our lending rights are, would improve competition and would help the central bankers keep track of what credit conditions were like.

I actually think I am more radical than that, I think when the central bankers change the riskless interest rate they already know that they are affecting the whole credit surface. When they lower the riskless interest rate, they know that is probably going to lower the rate that risky borrowers

pay and they know the risky borrowers are the ones who drive the economy. But sometimes when you lower the riskless interest rate, part of the credit surface changes and not the other part of the credit surface; that is why I want central bankers to think and be forced to say what they are doing, what they think they are going to do to the whole credit surface. I think it will be very disciplining about their thinking.

Thirdly, I actually think I am being even more radical. I think that the bankers can influence directly different parts of the credit surface. This happened in the crisis, that no one would lend car loans, student loans, credit card loans, and the Federal Reserve lent directly to people at higher LTVs than the free market would. So, I think that it is possible to lend directly. The bank of Israel said: “Things are getting too hot in the housing market, we are going to prevent anyone from taking more than a 60% LTV loan.”

That action was not directed at interest rates, it was directed elsewhere than the credit surface. The risky borrowers now can get a loan at more than 60% LTV, so it's possible for a Central Bank to intervene not just at the interest rates but also elsewhere on the credit surface. I think central bankers should think more about that and I predict that in 20 years they will be doing that.

One last more radical thing- more radical still. If you think about the whole credit surface, you have to think about default. That is why the interest rate is going up, because people are worrying about default. So if you acknowledge that there could be default, you have to acknowledge that you could lose money as a central banker. Central bankers never think about... maybe they do, but they never admit that they could lose money. If you know that you could lose money on a loan, that means that partially forgiving the loan could make you money because very often if you forgive part of the loan, the borrower will pay the lower number when they would not pay anything on the higher number. So if you acknowledge the fact that you could lose money and you calculate what the value of the loan is, that leads you to think of potentially forgiving loans. As a result, I think forgiveness is another tool that the Central Banks should think more seriously about. They are a little slow sometimes. But you wait, they are going to forgive.