

CONFERENCE¹: AN INTEGRATED FRAMEWORK FOR MULTIPLE FINANCIAL REGULATIONS

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I am going to begin by giving my description of what happened during the crisis, focusing on the events in the fall of 2008, and early 2009. After explaining what I think went wrong, I am going to talk about some work that is really in progress on regulatory policy that tries to address some of the problems that we have seen.

I describe the crisis as a series of things that look like bank runs but were not runs on traditional banks. In fact, in Europe we are still living through a crisis that has a run element. Just to remind you, an institution or a market structure that is susceptible to run, must satisfy two requirements. First the person providing the financing must think that, by taking his money out sooner, he will get more than by waiting; the second thing is that when the first person takes his money out it has to make others more likely to take their money out. So, any time you have a funding structure that has those two characteristics, you have the possibility of a run.

When we think of the Great Depression, we recognized bank runs crippled many countries' banking systems, and so we invented deposit insurance. For most economists, I think, if you'd asked them in 2007 "Is the financial system going to be vulnerable to runs?" they would have mostly said "No, I highly doubt that runs are going to be much of a problem because deposit insurance cures that difficulty."

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But, in fact, what we saw over the last four years is six different runs. The first one came in the asset-backed commercial paper market where many companies that had been relying on this funding source saw it disappear essentially in four months between August and December of 2007. That funding structure has basically not come back. That was the first run.

The second run happened for Bear Stearns as it lost its liquidity over the week before Saint Patrick's day in early 2008. Most people understand that Bear Stearns had a lot of trouble rolling over its financing over but, if you talk to the people at the Federal Reserve Bank of New York, the reason why they recommended saving Bear Stearns was because the repo markets would have stopped working the following week if Bear had been allowed to fail. When Bear failed, the last day that it operated before it was acquired, it actually had Treasury bills that it could not repo. This is very, very surprising that the counterparties had lost such trust that on the final Friday they had Treasury bills they could not repo. So they were subject to a massive run by their repo counterparties.

One of the things that I learned from reading Darrell Duffie's work is that, to this day, prime brokerage firms extract liquidity from their operations vis-à-vis their interactions with their customers. There are two ways that broker dealers get liquidity just in the course of providing prime brokerage service. One occurs because in the derivatives market it is commonplace for the large dealers to not post as much collateral as others in the market. So, any time you see a derivatives contract between a prime broker and a customer, there is a reasonable chance that the broker, if you were to close out the position, will have to settle up a certain amount. As customers become concerned about the viability of a prime broker, they start closing positions with that broker and putting them on with others. As they do that, the broker usually has to settle up and close out positions and provide liquidity. That is one way that they provide liquidity. So, whenever your viability comes into doubt, chances are you are going to be subject to a withdrawal of your customers and your counterparties.

The second thing is, even in the United States, if a customer has a deposit with me and I am a prime broker, I am not allowed to use the securities that he is deposited with me to fund myself; but, if one customer has some surplus securities in his account and another is looking for a loan, I can take the extra securities from the first customer and fund another one of my other customers. That is the efficient thing to do, but it means that,

should the initial customer become nervous about my viability and withdraw his securities, then I have to fund the position with my own money.

The week after Lehman failed, Morgan Stanley lost 80 billion dollars in liquidity through the contraction of their prime brokerage business, a combination of mostly losing their customer accounts but also OTC derivatives closing out. So that's a fourth run.

The fifth run started the day after Lehman failed, when the money funds came under pressure. You know that the reserve primary fund lost about 2 cents per share – maybe 3 in the end. That caused a run on all the money market funds, the regulation of the money market funds presumes that they only invest in very high-quality, safe assets, but they do not invest in high-quality, safe assets that can be liquidated on one day's notice. They have a slight maturity mismatch, usually no more than a couple of months, but, if somebody wants their money today, the fact that you have it invested for two months is not good, so the US Treasury had to guarantee the money funds.

The final run is still underway now in Europe. If I am a depositor that has money in a Spanish bank and I am worried about the Spanish banks so I want to take the money and put it into a German bank, the way that the euro system makes that happen is they will have the Banco de España and the Bundesbank enter into offsetting transactions through the euro system where the Bundesbank will get a credit and the Banco de España will get a debit and they will owe money. If you look at what has been happening in the payment system in Europe, huge imbalances have built up. Basically, Germany and the other northern countries have more than 700 billion euros of credit that has built up. Again, this satisfies the conditions for a run because, if you think that Spain might leave, then you want to get out and put your money into some other countries that you think will retain the euro and, to an extent, Spain's ability to stay in depends on how much of their limited resources can be used to pay off different people, the sooner you do it the better. So that is another run.

All six of these things were central to the dynamics of what went wrong in the crisis. This is not the usual story you hear about what went wrong in a crisis, I will come to the more usual version in a second.

So, component number one is a run. Now, I want to give a little bit of an advertisement for this wonderful paper that my colleague Rob

Vishny has with Andrei Shleifer³. They wrote this paper called “Fire Sales in Finance and Macroeconomics” which is an elaboration of some work they started almost 20 years ago. They define a fire sale as

“essentially a forced sale of an asset at a dislocated price. A sale is forced in the sense that the seller cannot wait to raise cash, usually because he owes that cash to someone else. The price is dislocated because the highest potential bidders are typically involved in a similar activity as the seller, and are therefore themselves in a similar financial position. Rather than bidding for the asset, they might be selling similar assets themselves.”

Shleifer and Vishny (2011)

But there is these two components: it’s got to be the case that the price diverges from the present value of what the asset’s cash flows would be, and they argue that the reason that happens is because somebody who would normally be patient or would understand the nature of the cash flows and would be ready to pay the fair value is out of the market for some reason. In most cases, the reason they’re out of the market is that they need money themselves to satisfy someone else that’s making a call on them. So, that insight is important because it tells you that if a run is underway there’s the possibility that you’re going to set up the pre-conditions for a fire sale.

Now, if you look at what happened in the banking system, we get the second leg of the story. So the more conventional account of the crisis is to say that we had a bunch of de-levering. What do I mean by de-levering? Well, if you look at the most basic identity that links the capital of the financial institution to its risk, you get the following identity:

$$E = \text{equity capital} = \text{value at risk per dollar of assets (v)} \times \text{total assets (A)}.$$

But if you rearrange the identity by dividing assets by equity to get leverage, you see that leverage is going to be inversely proportional to value at risk:

$$\text{Leverage} = A/E = 1/v$$

³ Shleifer, Andrei and Robert Vishny, 2011, “Fire Sales in Finance and Macroeconomics”, *Journal of Economic Perspectives*, 25(1) Winter 2011, pp. 29-48.

So, if there are fire sales underway that make prices look more volatile, your value at risk is going to be higher and any financial institution that is managing itself by looking at value at risk is immediately going to have to shrink its balance sheet. But, of course, as they are shrinking their balance sheet, then that pulls buyers out of the market who would be normally there to stabilize prices and you get a spiral that is potentially reinforcing.

We do not quite understand why this is the case but it is pretty clear regularity that during booms price volatility and value at risk are low and then during busts all of a sudden risks become apparent and value at risk shoots up. Just to take one example. In Table 1 there are the four former investment banks in the period leading up to when Bear Stearns failed. You can see that the value at risk more than doubles. So, by the conventions and the regulatory environment that we were following prior to the crisis, every firm was encouraged to use value at risk to communicate to the regulators what they were doing. Just mechanically, when you see value at risk double like that, that means that they are going to have to shrink their positions. So the de-leveraging is something that is a real problem because it tells you that, as these risks start to appear, the natural buyers in many markets will step out because they are going to be faced with higher perceived risks and more potential claims on their capital.

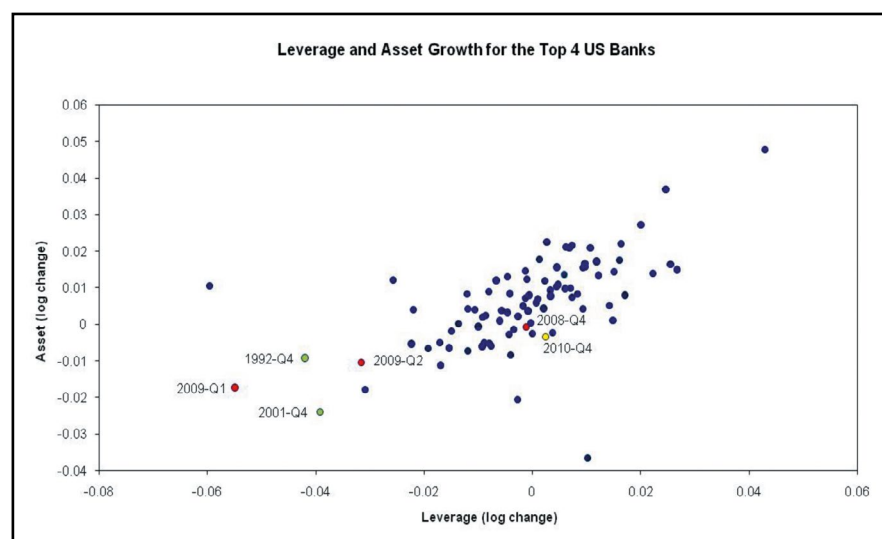
Table 1. Measured VaR for Selected Firms

	Feb-08	Nov-07	Aug-07	May-07	Feb-07	Nov-06	Aug-06	May-06
Lehman	130	124	96	78	63	48	35.2	35.1
Goldman-Sachs	157	153	139	133	127		92	112
Morgan Stanley	103	98	87	81	90	61	56	63
Bear Stearns	59.2	45.5	32.2	27.7	27.2	27.5	29.2	33.7
Lehman	3.70	3.53	2.74	2.22	1.79	1.37	1.00	1
Goldman-Sachs	1.40	1.37	1.24	1.19	1.13		0.82	1
Morgan Stanley	1.63	1.56	1.38	1.29	1.43	0.97	0.89	1
Bear Stearns	1.76	1.35	0.96	0.82	0.81	0.82	0.87	1
Index	2.12	1.95	1.58	1.38	1.29	1.05	0.89	1

Now, the same kind of calculation for the largest US banks is presented in Graph 1. Along the bottom is the change in leverage and on the y-axis is assets. You can see this is a pretty strong relationship. I picked out the last three recessions and you can see that at some point during a downturn the large banks in the United States always conclude that they cannot handle the amount of risk they have and they massively de-lever and

they do it by shrinking their assets. The chart shows that the deleveraging we saw in the most recent crisis was also present at the end of the 1991 recession and in the 2001 recession. So this is a pervasive phenomenon.

Graph 1. Procyclical Leverage for U.S. Banks



Source: Author's calculations

We care about de-leveraging for two reasons. First because it explains the amplification of shocks. One important fact to keep in mind is that estimates of total losses for the sub-prime mortgages in the United States were modest, perhaps somewhere between \$600 billion and maybe as high as a trillion. A loss of 600 billion dollars is one bad day in the stock market. So, there are lots of days over the last 20 years where the US stock market has lost more than 600 billion dollars for the ultimate owners of the stocks and yet we don't have financial crises every time that happens. But, when this happened in 2006 to 2007, capital markets became severely compromised. How do you get a shock that small to cause so much trouble? Well, you need a lot of leverage and you need value at risk going up and pressure to de-leverage. So that's the first point.

The second point is, as the de-leveraging is happening, you could expect markets where these levered financial institutions are important buyers to become dysfunctional. I will show you a couple of pictures in a moment about how that was playing out in the fall of 2008. I think the most interesting question is whether or not there's some mechanism here that

you can use to explain the fact that Reinhart and Rogoff emphasized about recoveries after financial crises being slow. The story, which I think is not proof but it is a kind of consistent one with that view, is that, as the banks have to repair their balance sheets, they make credit availability very tight and the lack of credit availability then slows down the recovery. So you get kind of a slow recovery, perhaps, because the de-leveraging takes much longer than just the length of the recession.

If you could asked me in 2007 "Do you feel that fire sales are an important thing?" I would have said "Well, we have models that say they are but I don't know that in the real world they are very relevant." If you had done a survey of the literature on fire sales, you had relatively few empirical papers documenting them. Maybe the best evidence was on airplanes. It showed that if you have to sell certain types of airplanes and there are only certain airlines that actually use those planes and you have to do this quickly, you'll find that the price is dislocated.

OK, fine. So airplanes are subject to fire sales, but surely not financial securities. But I think the biggest "Aha!" for me was to see how the financial system crumbled in the fall of 2008. I remember talking to a friend who was working at a large bank in the fall of 2008 and he said "Do you know the covered interest parity isn't holding right now?" And I said "Surely you can't mean that, you must mean uncovered interest parity." And he said "No, covered interest parity." If you go and look at the way most people teach the definition of arbitrage, it is by explaining covered interest parity.

I define interest parity as borrowing in one currency at a certain interest rate, changing the money into a second currency using the spot exchange rate, lending the proceeds in the second currency, getting interest in the second currency, and then entering a simultaneous contract to transfer the proceeds back into the original currency. The reason why this should be arbitrage is all four of the key prices here (the spot rate, the forward rate, and the two interest rates) are known at the time, every moment, so you can look on a Bloomberg screen, you can look at those prices and, if they diverge, this is literally free money, this is a 100 dollar bill lying on the street. Yet, if you look at what happened starting in August of 2007 but then really in the fall of 2008, anybody who was able to go short, the dollar side of this kind of trade could earn huge profits. And these are riskless profits, these peaked at annualized 4 rates of return of four percentage points, which is astronomical. Think about it, hedge funds spend all their time vacuuming up nickels and here's a thousand dollar bill lying on the street.

There are many, many other examples of financial markets that normally do not show these kinds of violations that sprung up in the fall of 2008. I think that any successful account of the crisis has to come to grips with the fact that arbitrage had stopped working. I think it is very interesting in the case of covered interest parity because you cannot use most of the obvious explanations for why there should not be there. This does not depend on any counterparty risk, you can execute this through exchanges that are well capitalized, and yet you see it. And it was very particular. If you look, in other markets where you did not have to take a position in the dollar, there was not any puzzle; there was not any excess profits to be made. So, there was a shortage of dollars that was very, very apparent in the fall of 2008. I gave the Mundell-Fleming lecture at the IMF a couple of years ago and I had a list of all the markets that broke down; Darrell Duffie's presidential address at the American Finance Association, includes another set of examples of financial market prices that looked wrong in late 2008 and early 2009.

So this is a long way of motivating my answer to the question of "What's macroprudential policy and what's the point of it?" I would say the point is two things: to prevent the deleveraging and to minimize fire sales. We try to avoid these things ahead of a crisis and if you get into trouble try to minimize them going forward. I see that as the purpose of what regulators should be doing when they are talking about macroprudential policy. But of course, if you are going to do that, then you need a theory for how this can happen, you need a model that is going to have a fire sale that could arise endogenously in order to talk about how you might prevent it or regulate people. That is what I am going to spend the rest of the time talking about.

Now we are going to look at a very specific model. The material that follows now comes from two papers, both of them by the same authors: Charles Goodhart, Dimitri Tsomocos and Alex Vardoulakis. One of them is an NBER working paper⁴, the other is going to come out very soon in *International Journal of Central Banking*⁵.

⁴ "Financial Regulation in General Equilibrium", NBER WP 17909.

⁵ "An Integrated Framework for Multiple Financial Regulations", *International Journal of Central Banking*, vol. 9 (S1), pp. 109-143.

For getting started, I think it is helpful to remind you of the Modigliani-Miller assumptions that imply the irrelevance of a firm's capital structure. I'll do that because if you are not precise about what is gone wrong in your model the financing arrangements for financial institutions may or may not matter. So, if the M-M assumptions are right, then you can't have fire sales, you cannot have credit crunches, you cannot have de-leveraging matter in any way because somebody else will just step in and buy.

If you recall, Modigliani-Miller depends on three conditions:

1. Investors and firms can trade the same set of securities at competitive market prices equal to the present value of their future cash flows

No fire-sales

2. There are no taxes, transactions costs, or issuance costs associated with security trading

No bankruptcy costs

3. A firm's financing decisions do not change the cash flows generated by its investments, nor do they reveal new information about them.

No incentive problems

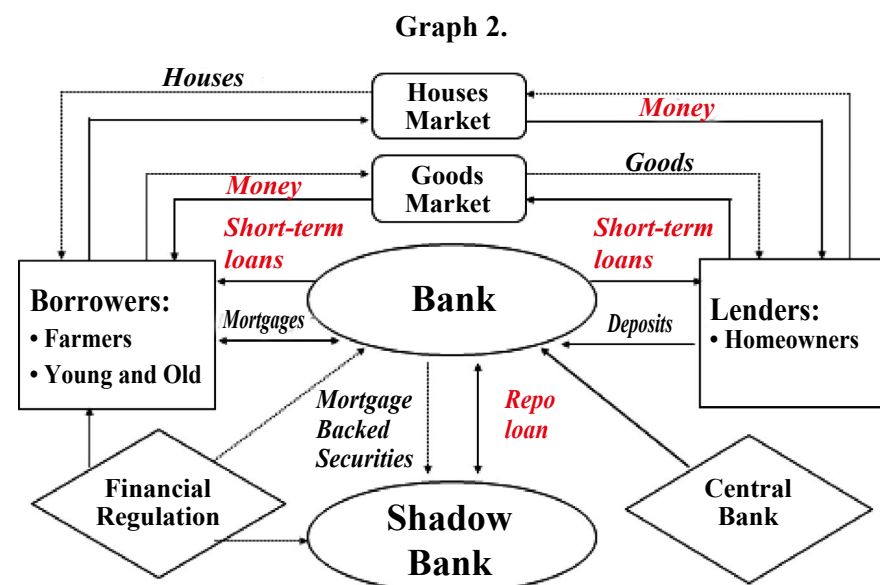
Those conditions say, importantly, that you cannot have a fire sale because it is assumed that there is always enough people around who are informed so that prices are always equal to the present value of the cash flows. It also assumes that if there is anything like a default you just costlessly transfer the assets to whoever was owed the money and nothing gets dissipated, so a bankruptcy or a default is not a big event. And it also says that you do not have to worry about the motives of any managers that are running financial institutions. We are going to propose a framework that is going to violate each of these three assumptions.

The perspective we are going to use is one that Charles and Dimitri have been working on for almost a decade now, in fact last year they came out with two books that collected many of their papers. The basic framework that they start from is to say that markets are not complete and that there are heterogeneous agents. Putting together incomplete markets

and heterogeneous agents means you have a motive for trade right off the bat. The versions that we are going to look at today are just going to have two goods, but you can have many goods that people are trading. The particular parameterization for today's talk to mean that, left to itself, the economy would settle at a place that is pretty inefficient. So that means that you might be able to introduce regulation to achieve a better outcome and we are going to have three problems that follow from introducing a financial system.

I will go on much more about these, but just to get things started. There is going to be default, there is going to be a credit crunch and there is also going to be the possibility of a fire sale. While I am not going to say very much about it, we are going to assume there is cash in advance constraints so there is actually money in the model. Someday one could study monetary policy in this framework, but I am not going to say anything about that today.

Figure 2 shows the whole model in one picture. The starting point is some presumed heterogeneity between borrowers and lenders. They differ in their endowments of goods. One is endowed with a durable good that I am going to call a house and the other with a non-durable good that I am going to call a potato. Given the differing endowments the goal of the agents is to swap some houses for some potatoes.



- **Amplification of fire-sales due to repo loan**
- **New credit extension in the second period=possibility of credit crunch**

The basic arrangements require these guys to use money as a means of payment when they try to go and exchange their houses and potatoes. We are going to set up the endowments so that people with the houses are relatively wealthy, so they are going to be the ones that are going to do the lending to the people with potatoes.

We will create a financial system that assists in the transactions. We are going to have a bank that provides several services. One is to make some short term loans to help with the cash in advance problem. More importantly, the bank can take deposits from the rich people and then use them to extend credit to the poor people. One thing that I think is important –and it would be really nice if the people in the United States, or the Occupy movement understood this– is that the financial system here is trying to help the poor people. The rich people have all the money they need and for them actually the absence of a financial system is a bit of an advantage because they could extract much better terms for its loans if there was not a financial system. So, the point of the financial system is to try to improve the outcomes for the less wealthy people.

Because we are going to want to investigate a bunch of different regulations, I am going to go just beyond having a bank, so we also allow the possibility of a shadow bank. This shadow bank is going to be set up here so that, in addition to holding mortgages on its balance sheet, the bank can actually securitize some and sell them off to the shadow banking system, but it's going to do it with a repo loan. The reason this is going to be interesting is because when, problems occur in the shadow banking system, the regular banking system is going to get infected because the repo loan will go bad. The question we are going to ask is "Can you think about financial regulations that would intervene to make this system more stable?"

Before I tell you how everything works, it is useful to understand the basic uncertainty that's present in the economy and also to ask "What would happen in a set up like this if there was not a financial system?" Those are two helpful benchmarks.

There are several sources of uncertainty, but I am really just going to focus on one of them. The main source of uncertainty is whether there is a good or a bad harvest. If there is a good harvest, then there are plenty of potatoes around, which means that the price of potatoes is going to be low, but it means there will be lots and lots of potatoes to repay with in

the future. We are going to set the model up so in the first period all the two agents are doing is trying to trade houses for potatoes to equate the marginal utility of both, then in the second period there is uncertainty, about whether potatoes will be plentiful or scarce, and that is the central source of uncertainty in the model.

I will not discuss it but there could also be uncertainty over the monetary endowments in each period. So for today main thing you should be thinking about is whether there'll be a good harvest, and let's say that most of the time there will be.

The problem is going to be that, if there is a bad harvest, then mortgage loan that the poor households have taken out will be defaulted upon. The default itself between the borrower and the bank is unavoidable, since it reflects a resource shortage and there is nothing financial regulatory policy can do about that because regulation can't change people's wealth.

But we are going to have three sources of amplification that come because of the presence of the financial system. The inefficiencies here come not from the first default but from all the knock-on effects. The point of the financial institution is that most of the time, by letting you pull forward some of your second period wealth to buy a bigger house today, you're improving everybody's outcome, so the poor people are better off. If there wasn't a financial institution and there was kind of no way to enforce repayment, the poor people would just have to live off whatever their endowment is during the first period, and if it turns out that there is going to be a boom in the future there'd be no way to take advantage of this.

By setting up the bank you're able to smooth some of that out and so the question is "Is the additional smoothing you get by introducing the bank enough to compensate for the fact that when things go wrong the bank is going to potentially make things worse?" Then we are going to entertain regulations.

What would happen if there wasn't a bank? Suppose there was somebody just dealing with the cash in advance constraint. Well, the rich households would be just fine, they can basically self-insure, they don't need a financial system, they have enough houses so that they can use the combination of whatever cash they've got and their house so that they can smooth their consumption across periods. The poorer households, the farmers, would only be able to get their period 1 allocation right and they

would just have to live with the uncertainty as to whether or not in the second period they'd do really, really well or not. So, in a non-financial economy, you'd have kind of this unfortunate situation where the poorer households are going to have lots of fluctuations in their consumption and there is nothing they can do to insure against it.

What happens when you introduce a bank? Well, if there is a big harvest, the price of potatoes is low and the price of houses is high, meaning that there is a house price boom, so paying back the mortgage is easy, and the economy cruises along without any problems. So that case is not very interesting.

More interesting case is when there is a famine, so there are not enough potatoes, in which case the price of houses is low and the price of potatoes is high, meaning that there is a house price crash. In that case there is a cascade of bad things that can potentially happen and, the way we have calibrated the model, all of these things will happen.

So, the first thing that's going to happen is that the non-bank is going to decide that it would rather just return the collateral that it has rather than repay its repo loan. It is going to default on its repo contract and that is going to impose losses on the bank.

The bank then defaults on the rich household by not fully repaying its long term deposit promise, that is the second thing. Now both of those things are amplifications of the original default, those are not inefficiencies that are coming because of the famine, they are inefficiencies because the financial contracts make things worse than they would have been otherwise. Because the bank has defaulted on its deposits and its capital is lower, its ability to make loans is going to be reduced.

One thing I skipped over is that we actually have two types of poor households: young households that live are present in period 1 and period 2. Because we haven't really figured out how to do the fully dynamic version of the model, as a short cut, we also have some new poor households born in the second period. These new households are important because, if they were not there, whenever there was a default the same people who defaulted would end up just buying back all the assets and the default would not be very interesting; so our short-cut insures that somebody else shows up after a default and faces a dislocated price.

The third thing that can go wrong is that the bank, in trying to repay the deposits that it owes, can decide to try to sell the mortgage-backed securities that it has received from the non-bank. Here we follow the work that Franklin Allen and Douglas Gale have done and say that we're going to hard-wire in the possibility of a fire sale.

How do we do that? We say well, the only people that can buy the mortgage-backed securities are those same non-banks that just defaulted. They are going to have very little capital and that means the more mortgage-backed securities you try to sell, the more you are going to depress the price because the financial buyers just do not have enough wealth to pay what the present value of the cash flow is going to be. In that case, you will do all this, this will go ahead and force the person that is arriving on the scene for the first time to have to face worse prices for housing so they will have to rent a smaller house and the person who has defaulted will move into a smaller house.

This has, as I said, a bunch of inefficiencies. The most interesting one, I think, is the fire sale. Notice what happened here. We started out with a famine so we had a fall in house prices and that led to a default; because of the default, the mortgage-backed securities declined in value; because the mortgage-backed securities decline in value, the shadow banks default. When they default the bank then fire sales some of those same MBSs, which causes further losses for the bank. When the bank suffers those losses, they make less loans available and, because of that, the house price falls further and you get a potential cycle.

All this is possible because the bank, in the second period, is making an active decision about whether or not it should retain mortgage-backed securities and try to speculate by holding those or whether it should hang on to loans. So, the mortgage-backed security price and the house price are exactly connected and, because of this Allen and Gale cash in the market pricing, the more mortgage-backed securities you sell, the more the price has to fall because the equity, or the wealth, of the non-bank is fixed. But, of course, when you drive down the MBS price, the house price has to drop too, otherwise the capital gains would not be equated. So, when you get these fire sales, they affect the real economy.

This is an incredibly complicated model, I admit. In fact, it is so complicated I am not sure whether anybody else will ever use it and we are

trying to simplify it so it is a little bit more friendly. But the reason it is so complicated is because it is the only model I have ever seen that allows you to talk about all five of these potential regulatory tools. If you think about it, most of the discussions you see about financial regulation maybe you have a liquidity coverage ratio and a capital ratio, but rarely do you have the possibility of talking about something like a loan-to-value requirement, or a haircut, or loan provisioning rules. All of those things can be easily examined in this framework.

You can also extend the model even further to talk about other tools such central bank's lender of last resort policies, taxes on bank size or deposits, regulations on debt-to-income ratios or imposing sectoral capital buffers. The cost of figuring out how to work with this model is incredibly high but I would say the payoff is also quite high. But the only thing we have not figured out how to do is to set up the possibility of a bank run, there is really no scope for a bank run in any of this, so we cannot analyze anything like net stable funding ratio.

Let me talk a little bit about the results we have so far. I would say the single biggest lesson, for me, that has come out of playing around with this model is a different way of thinking about these regulations. For example, I think most discussions proceed under the assumption that capital regulation and haircut requirements on repos are fundamentally different because, capital requirements impinge on banks whereas the haircut or margin requirements are operating on the non-banks. So one might think of these two tools as very different policy levers. Our analysis suggests that rather than grouping things in terms of their incidence, you should step back and think about which channel the regulations influence. Do they help with the fire sale? Do they help with the credit crunch? Do they help with preventing default? Rather than grouping things according to the party that is affected, think of them through trying to reduce one or more of those channels of financial contagion – that is really the right way to think about things.

So, how does a countercyclical capital requirement work? The most natural way to think about a capital requirement is that it can potentially lessen the fallout from the repo default. If the bank is sufficiently well capitalized, even if the repos are defaulted upon, the bank need not default on its deposit contract. If that's what happens, then you stop that channel of contagion. You can also use capital requirements, potentially, to reduce the amount of credit that gets extended in the first place, so you can limit the size of the initial default.

Because we have set up the non-bank the way that we have, in this model we also have regulatory arbitrage alive and well. So, if you raise the capital requirement, which makes it more expensive for the banks to issue mortgages or to make mortgage loans, one thing that can happen is for the bank to make the loan and then immediately securitize it. So, when you introduce a capital requirement you're going to tilt the playing field between the bank and the non-bank, which is an interesting thing that I think is quite realistic.

For the calibration that we analyze in the forthcoming paper, what happens is that, when you increase the capital requirement, you are going to reduce the total amount of mortgages that are issued but have more of them securitized. Because the households are able to get less credit in the first place, when they default, the default is less severe.

So, one of the shortcuts that I did not mention that we would take in the paper is to model default we follow another literature that says "default is bad because of many things, so let's approximate the cost of default as just being a proportional tax on the amount that you default." If I default a million dollars, I pay a penalty, τ , that's proportional to a million; if I default on 500 thousand, then I pay τ times 500 thousand. I sidetrack all of the complications that you would get about modeling the consequences of default. So, if you have fewer defaults, the households will be better off here eventually.

One thing that is interesting –when we first started playing with this model I thought it was a defect, but now I think is a strength of the model – is that in the world where house prices are high because of a good harvest, the bank makes a lot of profits on the loans that are extended in the initial period. That means that their capital ratio looks very, very good, so good in fact there is no risk after a harvest. So, the capital ratio just fails to work during a boom because the banks are looking so good. If you think back to, say, early 2007 and ask yourself if people at that time worried about the degree to which, say, US banks were capitalized, there was almost no one that was saying that; in fact, I am sure you could probably find some quote I would have given to a journalist saying "Oh, the banks are better capitalized than they've ever been, so we're in a great position if something goes wrong." Then two years later they were all broke. So at the peak of the boom capital ratios look good and then once the losses arrive the capital quickly goes away.

How does a haircut work? Well, you could think of a haircut as basically trying to raise the cost of repo financing and so it is a lot like imposing a capital requirement. By making the non-bank put more of its own capital into each security that it buys, you build up a bigger buffer so that, when default happens, the costs that fall back into the banking system are reduced. This will tilt the playing field now away from the non-bank, so you will end up getting less repos, you will have mortgages that are more expensive. Notice what the non-bank does here is that it improves risk sharing because it is got some capital that allows it to bear risks. Having the non-bank participate in the mortgage market means that there is more risk bearing capacity in the event of a collapse, so the non-bank makes the world a better place because it is improving on sharing of risks. But when it defaults, of course, you get this amplification.

You get less repo financing because the bank then has to do more of the work itself, it is more expensive to lend so there will be less mortgage credit, it will hold a higher fraction of whatever it does initiate on its own balance sheet, and it means that it will be less tempted to default on the rich household when the repo goes bad.

What does loan-to-value regulation do? Loan-to-value caps what the borrower's and lender's exposure to asset price declines will be because it says that instead of borrowing 90% of the house you can only borrow 80%, so that if the house price drops, let us say, by 15%, in the first case you would have defaulted but in the second you will not. This is can be a really powerful tool since it amounts to rationing credit. Credit rationing might be a good thing if it turns out that there is going to be a lot of default, but if it turns out that there is no default then all you have done is prevented consumption smoothing; put differently, this reduces fire sales and instability but it does so by restricting access to credit. Loan-to-value regulation is also not going to be a very good tool if it turns out that there is a house price boom because then you make a big capital gain and all of a sudden you have got plenty of equity.

The liquidity coverage ratio operates by forcing the bank to hold some assets besides just the risky mortgages, so it means that, should the bank get hit by a default, it has something else it can sell rather than the MBS to repay its deposits. This works kind as direct fire sale protection. This is another preemptive tool, it is going to mean that the bank is going to reduce its mortgages and reduce the amount of mortgage-backed securities,

but that raises the cost of credit and it means that the bank is going to allow the households to engage in less smoothing. Should there be a default, it will be less extreme and deposit repayments will be higher.

One thing that is very important –as Charles (Goodhart) emphasizes quite a bit– is what do you do in the case when there is a house price collapse? Do you insist that, even then, the bank has to hold liquid assets? If you do, then you make the credit crunch much worse and you make the fire sale worse as well. So, if you say that you are holding this liquidity but you cannot actually use any of it in the event of a crisis, that is a pretty dumb tool to use. This kind of policy delivers a really nasty fire sale. Charles has a joke... If you say there always must be one taxi at the taxi stand, that last taxi doesnot work very much because, even if it is raining and you donot want to walk, there's always got to be one taxi at the stand, so It is useless. So, having the liquidity requirement that says you always have to have a certain amount of liquid assets that you can't draw down has the same property. It sounds kind of absurd when it is put this way, but there is actually a huge debate underway in Basel about the liquidity coverage ratio, about whether it should be constant or time varying. Some people argue that it is defeating the purpose if you let it vary by time. I would say no: exactly the reason you have insurance is to draw it down.

The fifth tool is very different than all the others. We model it as a restriction list that just says “If you want to make more real estate loans, you have to put aside more money for losses.” I flip-flop between whether or not this is a crazy tool or a very clever one. It is the only one that directly leans against the boom in any meaningful way because it says that if you want to engage in a lot more real estate lending in the good state it's going to be more costly. You can see that it is going to look nice because it is much more state contingent than the other tools, so the fact that it is good, in some sense, is a little bit of an artifact of having just two states of the world and allowing this regulation to operate in the good state of the world. It means that you are going to get less mortgage extension during the boom, which is going to lead to some funny things. If the bank knows that it cannot lend as much during the boom, it is going to shift some of its activity from period 2 back into period 1. In fact, most of these policies all work through these kind of general tradeoffs where the bank or the non-bank, whichever one is being hit by the regulation, starts looking ahead and has rational expectations and adjusts its policies in the first period to deal with the fact that there are going to be problems in the second period.

It is convenient to categorize the different tools according to what they do to a couple of key margins: the price of houses relative to potatoes in the first period, the amount of securitization, and the profits of the bank. The other shortcut we take besides having the default penalty is that we make the bank and the non-bank risk averse, that way you donot get to any cornersolutions in their portfolios. A little bit of risk aversion is enough for them to want to smooth their profits and allows you compare their profits in the good state and the bad state.

What do we observe? I'd say the second lesson from the model (the first one was “think about the channels through which regulations operate”), is that regulations that look potentially similar when you are thinking about them one at a time can interact in funny ways. I think this is one of the dangers of the way we are going. Everybody is in favor of having a liquidity coverage ratio, there is a lot of praise by regulators about this, but almost no one has written down a model that tells you how liquidity coverage ratio interacts with capital ratio and it turns out there can be some interesting things.

The loan-to-value and margin requirement essentially operate in the same way. Both of them reduce credit in the first period. The loan-to-value ratio is more extreme because it directly rations the amount of credit, whereas the margin requirement tilts incentives towards making the bank do more of the lending. The capital ratio in period 1 is a little bit like a margin requirement too, so you could imagine grouping these three things together and saying that they are all going to work essentially through the same channel.

The capital ratio in the second period and the dynamic provisioning in the second period are also kind of similar in that they're kind of trying to deal with the problems after the fact.

We find that in most cases the rich guy's utility is unaffected by regulation. Why is that? Well, again, because they can use the cash and the houses to insure themselves, they donot really need a financial system. The only way a regulation can affect them is whenthey essentially reduce the value of the endowment. You might wonder how that can happen. Well, if you say that thereis dynamic provisioning requirements and say in a good state you just cannot lend as much, then that means the value of the housing is going to be lower and that's going to be like taxing the endowment of

the rich guy. The liquidity coverage ratio has a similar effect. If you impose that in the first period, then that means, again, that you cannot extend as much credit against the houses and that makes the houses less valuable.

So those two requirements actually hurt the rich because they essentially tax the endowment. For any of the other regulations the rich household adjusts his housing sales and cash holdings so that he is left more or less unaffected.

The poor agents, on the other hand, cannot usually evade regulations. So, when you implement the liquidity coverage ratio requirement, because you are taxing the rich guy, you are subsidizing the poor guys and they are going to end up being better off. The bank's payoffs will depend on exactly what happens.

When we put these things together, the combination that comes out best is a countercyclical capital requirement along with the margin requirement. Those actually leave the rich guy unaffected and reduce defaults, making the financial firms better off, and do not interfere with credit availability too much so that the poorer households are better off. When you substitute and you put in, let us say, the liquidity coverage ratio for the capital ratio in the second period, you actually make the new home buyer worse off.

It would take me too long to go through all of the intuitions about how the various regulations interact, you can read that in the paper, but I think that the big take away is that, when you start putting together these tools, you can take tools that look OK by themselves but, when you combine them, actually push people into worse positions. This model is still in its early stages, but I think it has already taught us some interesting things.

Let me close with a couple of bigger picture thoughts about what is going to happen if we move beyond just capital regulation. I think there are three things about liquidity regulation that are very, very important and that are not getting enough attention. If I was advising what to work on in this area, I would say "Think more about liquidity regulation."

So, the first thing is what happens if there are not enough liquid assets? Obviously Greek debt is not liquid even though it's counted so by

the regulations. There is potentially a lot of the European sovereign debt is not going to be safe enough to serve as a liquid asset. I am also quite worried about Japan once Europe gets sorted out. What do we do if there are not enough liquid assets and do we want to resort to financial engineering to make more liquid assets is something that I think is a good question.

The second thing is, if we think about imposing this liquidity provision and we reduce the amount of maturity transformation that the banks engage in, how socially costly is that? There is no analogue to the Modigliani-Miller theorem to tell you anything about how to think about maturity transformation. There is no natural benchmark that says "here's the right amount of maturity transformation" and "here's the social value of conserving liquid assets and using them quite efficiently." If you do not know what the benefit is, it is hard to think about what the cost of restricting things are. I don't think we have a very good answer to that.

Finally, there is the fact that there is so much liquidity provision that comes from the non-banks. As I said, the prime brokerage example is one good, very vivid, example of where liquidity is extracted from customers. The markets know this. If you look at Morgan Stanley and Goldman Sachs and you compare their CDS price to Citigroup's, Citigroup is trading way below its book value yet, because they have deposits, and perhaps also maybe because they are too big to fail (I am not sure how much weight to put on both of those things), the Citigroup's CDS price is about the same as Goldman's and Morgan Stanley's.

Why are Morgan Stanley and Goldman viewed as so risky? Well, it is because they are prime brokers and everybody knows that is where they get a lot of their liquidity. In the US there is a big fight about whether money funds should be regulated more tightly. They are providing some liquidity services, so how should we think about that? Modeling the liquidity provision by non-banks seems like a priority.

To sum up, let me say that we need to go beyond capital regulation, that if we've got these three channels of problems—default, credit crunches and fire sales—just one tool is not going to be enough to deal with them. We ought to be aware that, especially if we lean too heavily on capital requirements, we are going to push a lot more activity into the shadow

banking system but, once we start doing that, then we are going to be forced to come up with a model that looks more like the one that I have been talking about and very different from, say, the standard new Keynesian dynamic stochastic general equilibrium model that gets so much attention. Those models so far don't come close to making contact with the issues that are really at the heart of macroprudential policy.

Thank you.

QUESTIONS AND ANSWERS

Question: Professor, my question is a very practical one. Would you say that Basel III, in the way that it is written, has anything really meaningful over Basel II in order to prevent the likelihood of negative events?

Anil Kashyap: Well, I think it is still too early to tell. I worry that the liquidity requirements might be abandoned. I know that the regulators are insistent that they are going to do it, but we are already three years past the point when all this was proposed and we have made very little progress on the liquidity regulation. If Basel III ends up really just being more refined capital requirements, I think we are going to be very disappointed with it. If they get the liquidity requirements and particularly if they force everybody to hold some of these contingent convertible bonds that can be bailed in, I think we could be in a much better place. So I think it is too early to tell and it could still go either way, but to me the two biggest things that we need to see is more countries doing like what Switzerland's done to force a lot of CoCos into banks' capital structure and for countries to insist on some serious liquidity requirements.

Question: It seems to me that the other margin that might work better is to say that the firms that do a lot of transformation just cannot do things that are going to generate big losses. That is the prudential regulation problem. To force the business into the stock market is to say losses there don't hurt anything.

Anil Kashyap: I agree with that, that is partly why I said not knowing how costly it is to wipe out some of the liquidity provision makes it hard to know how far you want to go. I had a vigorous debate the other day on whether there is any synergy whatsoever between doing prime brokerage and doing kind of wholesale lending. I think you can defend the conjecture that there is no synergy there, so why those things should be stapled together is not so obvious. But, yes, to the extent that we can get more transparency around this, I think it is better.

The other thing I should have said about Basel III. There is this whole other narrative of the crisis that says the only thing that gets the bankers to respond in any way is when you interfere with their pay. The fact that their pay has never really been discussed in the U.S. is remarkable. It's going to be a fascinating experiment to watch what happens at UBS now that they

have thrown out all the stuff that generates these big bonuses and they are going to shrink back to wealth management institutions. It is going to be very interesting to see how that plays out because there's a big powerful machine that says that if you get into all this other investment banking type stuff you are able to boost the bonuses of the people at the very top of the institution.

One interpretation of what happened in the US was we did these magical stress tests and that is why the banks recapitalized. But another was that, at that very same time, we had Senator Dodd from Connecticut who said that anybody who takes government money is not going to be able to get paid bonuses. That was happening at the same time, so whether or not they raised the capital because the stress test worked or they raised the capital because they wanted to get paid, you cannot tell. But I think some more discussion about pay and about holding back pay would be a good thing.

Question: Since you have the tool there, it is very tempting to do some exercises. For example, my dear friend and boss Umberto (Della Mea) would say this happens in the first place because banks should be narrow. And then you have there a banking system and you have a shadow banking system. Have you had the time to analyze whether it's welfare improving to have one or other type of organization of the banking system?

Anil Kashyap: Yes. It is tricky here because the social value of the non-bank is hardwired into this model. If you threw away the non-bank, there'd just be less equity that would be there to absorb losses when the house prices collapse. The non-bank, by construction, provides more diversification and has some value. We calibrated it so that it is a little bit more willing to take risks than the bank as well so we gave it two advantages: first, it is more prone to take risks, which then allows for better sharing but, second, it does provide genuine diversification. I mean you could change the calibration so that it only exists to exploit regulatory arbitrage, but I don't think that is really the right way to think about the shadow banking system.

Then it comes again to the cost that Mike Dooley had mentioned. What is the cost if you cramp down on the liquidity provision, you make it all through the non-bank, you will have less of it? There will be less credit extended. How bad is that? It is very difficult.

Question: When you talked about dynamic provisioning you were saying that it is a way to stabilize prices. Have you thought about credit indexation as another way to stabilize prices in that sense?

Anil Kashyap: Let me see... So you want people to be able to hedge against house price increases, for instance?

Question: Yes, ex-post, that the payment is linked to the outcome as a way of insurance.

Anil Kashyap: I haven't thought about this, but I guess in this framework the poor households would like that a little bit. Anything that would remove price volatility would be a good thing as far as they are concerned. One thing I have learned is that it is very dangerous to speculate on how a new tool would work or interact with the others. Another way of thinking about it is a little bit like having a higher loan-to-value or a higher downpayment built in because, if it turns out that the losses materialize, they are not quite as big because you spread the pain around. But it is different in one important respect because it does make the bank share some of the losses. So I guess that could amplify things because in the downturn then the bank is going to get back the mortgage-backed securities anyway, they are going to be worth a little bit less but then they are going to take some direct write-downs right off the bat, so the potential size of the default on the rich houses is probably going to be higher. But we haven't analyzed that, it is a good one to think about.

Question: During the last crisis, particularly in Europe, there was a clear relationship between the bailout that was behind Europe prior to the G-20 meeting in March 2009 and afterwards, so, after they decided to go by themselves in 2009, this credit spread started to separate out and that is a testimony to the force that the implicit guarantee by the ECB had prior to that. And the recovery of prices in the last months in Europe shows how the reverse works. The ECB got back in and then things started to work fine, but, since you cannot have runs, you cannot have a financial safety net as lender of last resort. How would it look like in your model?

Anil Kashyap: I think it actually wouldn't be that hard to model. If we could get away from this two-period model and had instead a fully dynamic recursive model, then it would be pretty easy because what would happen is that the new born rich would just refuse to fund the bank. What would happen is that, if the bank gets into trouble, it would lose access to deposits. If we could just set this thing up as an overlapping generations model that repeated itself, then you would have something that looks a lot like a run. But the problem is getting the things the right way so you don't end up with too many state variables to carry around. That is one of the things we are working on right now.