

# Darrell Duffie

In the increasingly vital yet bewildering world of financial economics, Darrell Duffie is both a deep-level theorist and a hands-on plumber. He marries abstruse theory with solid reality and, unlike most economists, can then lucidly explain this often awkward union to those without his intuitive grasp. Few are better suited, then, to evaluate and clarify key challenges in the aftermath of the recent financial crisis. Duffie can't eliminate the fog, of course, but his insights are among the sharpest.

Over two decades at Stanford's Graduate School of Business, he has studied financial institutions and their networks, securities pricing, credit markets and risk management. This research is not light reading. He generates inscrutable papers on "ergodic Markov equilibria," for example, and was analyzing tri-party repos and credit default swaps before most economists knew they existed.

Fortunately, he also writes for the rest of us. Since the crisis, he has authored scores of commentaries and policy papers, testified before Congress and regulatory agencies, and written books that—in accessible language—illuminate murky financial markets and dissect systemic failure. The highest value of this "popular" work may be that after clarifying the weaknesses of existing practices or proposed policy, he then sets out better solutions that suddenly seem obvious.

In the June *Region*, Duffie guides us through the hotly debated Volcker rule, into the fragility of repo markets and the growing importance of central clearing counterparties, and then on to the mysteries of asset pricing. In the end, we're left with the uncanny (if inaccurate) sense that we actually see things as clearly as he does.



Photographs by Peter Tenzer



## IMPLEMENTING THE VOLCKER RULE

**Region:** Perhaps we can begin with the so-called Volcker rule, which would prohibit banks from engaging in **proprietary trading**.<sup>\*</sup> It seems to be among the most controversial parts of Dodd-Frank.

Earlier this year, you presented at the Securities and Exchange Commission (SEC), expressing concerns about the implementation rules being drafted by regulators, including the Fed, for the Volcker rule. Specifically, you highlighted the degree to which those proposed rules would reduce the market-making capacity of banks and that the void thus created might then be filled by the shadow banking sector, with potentially adverse consequences.

Would you briefly explain your concerns? And perhaps tell us why the costs that you envision might outweigh the benefits that Paul Volcker, the Fed and others foresee.

**Duffie:** Let's go back to the intent of the statute that Paul Volcker had in mind. As I take it, it's a good intent, which is to lower the risk of failure of banks because they are systemically important and



because we do subsidize the deposit insurance system. We wouldn't want to encourage risk taking by banks to become unsafe. So the statute starts by saying, OK, let's therefore remove some risky trading that the bank does on its own account, but let's not remove a number of things, the two most notable of which are underwriting, which was not my main subject, and market making, which was my main subject.

**Region:** What is "market making"?

**Duffie:** Market making is providing immediacy to investors. That is, when someone wants to buy quickly, you sell to them if you're a market maker. If someone wants to sell immediately, you buy from them if you're a market maker. And that provision of immediacy is done for an expected return that's designed to compensate the market maker for bearing the risk of changing its inventory to meet the demands of those investors.

So we have the statute, and now we're in a period, as you know, where the agencies, including the Fed, are charged with implementing the statute with rules: rule writing. That process has been delayed out of concern that the implementation the agencies have proposed might have unintended consequences. There were 17,000 public submissions on this—way more than any other rule-writing submission process.

Now, most of those are crank letters, but probably a few hundred or so are serious submissions. Some of them are

saying, "Pour it on. We do want to keep risky trading of all sorts out of the banks, and let's not make any allowances unless absolutely needed."

Other submissions, I would say probably a large number of them, are from those like me who feel that this will harm the liquidity of markets because market making will be unintentionally constrained by the proposed rules in a manner I'll describe in a minute.

As I also indicated in my submission, if the proposed implementation is adopted and once that void in market liquidity has eventually been filled, we'll have robust market making, but *not* within the regulated banking system. That leaves some concerns about financial stability. We didn't have a very happy experience with large nonbank market makers and other investment banks going into the financial crisis. Part of that experience was due to the fact that these firms weren't well regulated, even relative to banks. You could argue about the quality of regulation of banks, but I would say the majority view is that the investment banks, which at the time were not banks, were much more poorly regulated for capital liquidity and risk taking.

Now that might not happen. Because of the Dodd-Frank Act, we now have the Financial Stability Oversight Council, and it's charged with supervising the risk taking of large nonbanks. And we do have a regime of capital and liquidity requirements for broker-dealers. Some of this market making that would come out of the banks could go into broker-dealers, which would then be supervised by the SEC.

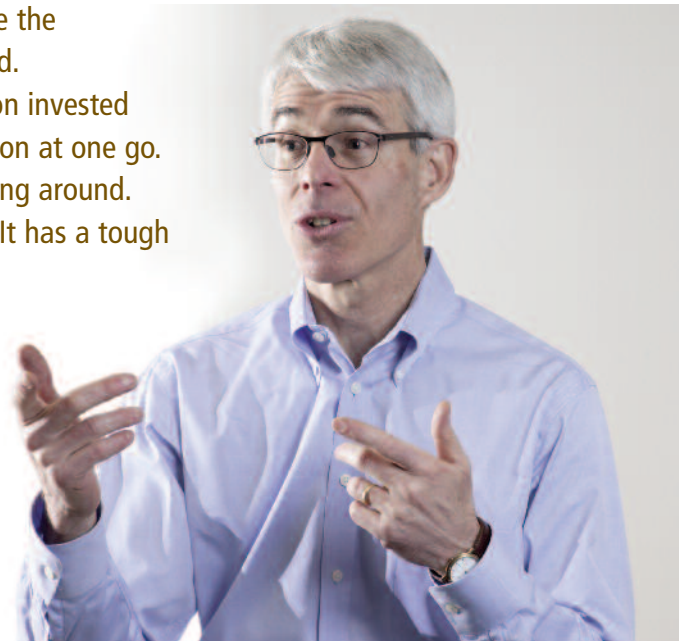
This will harm the liquidity of markets because market making will be unintentionally constrained by the proposed rules. Once that void in market liquidity has eventually been filled, we'll have robust market making, but not within the regulated banking system. That leaves some concerns about financial stability. ... I don't think we want to run that experiment.

<sup>\*</sup>Terms highlighted in blue are defined in a glossary on pages 26-27.



Loss buffers and conversion to a variable net asset value were the two alternate proposals that the Squam Lake Group suggested.

A third proposal is a redemption gate: If you have \$100 million invested in a money market fund, you may take out only, say, \$95 million at one go. There will be a holdback. ... These three main ideas are floating around. I feel sympathy for the Securities and Exchange Commission. It has a tough decision to make.



But I am concerned about that. The SEC doesn't have a great track record in that area. The capital and liquidity requirements are not under the **Basel III** process. They might adopt capital and liquidity requirements of that type, but they might not. And there is much more limited access to a lender of last resort from the central bank once you're outside of the regulated banking environment. There are some subtleties here, like Section 23A of the Federal Reserve Act, but I won't go into that here.

Overall, I am concerned about where we might end up. We might actually end up better than we are today; we might not. I don't think we want to run that experiment to find out.

Coming back to one part of your question, what is it about the proposed rules that might reduce market making in the banks and cause it to appear somewhere else? As you probably know, there's an approach in the proposed implementation of the Volcker rule that is based on **metrics**. The metrics themselves are not really the main issue. They raise costs for compliance and difficulties like that, which are not my main concern. The key issue is: How might those metrics be applied? In the proposal document, the agencies, including the Fed, are very cautious to say that they are not setting trip wires for these metrics. At this point, they are soliciting comments about how to use the metrics. They also say, however, that market-making profits should come primarily from bid-ask spreads, fees and commissions, and not from price appreciation

of the asset that's being taken on or offloaded by the market maker.

Whereas, in fact, if you look at the common practice of market making, it *does* include a substantial amount of risk taking that involves the market maker buying low and selling high later on in the market in order to profit from expected price appreciation. That's one of the ways that the market maker is compensated for taking large chunks of risk.

**Region:** But is that proprietary trading?

**Duffie:** Indeed it is. Market making is a form of proprietary trading that Congress decided to *exempt* from its proprietary trading prohibition.

The other aspect of the proposal document suggesting that this kind of robust provision of immediacy by market makers would not be permitted is language to the effect that sudden, dramatic, unpredictable increases in risk would be an indication of trading that is not market making.

In fact, while a lot of market making *is* of the small-risk flow trading type, there are *also* many cases in which an investor wants to offload unpredictably a large amount of risk and will call a market

maker to absorb that risk. That would run afoul of the Volcker rule if the agencies applied their metrics with that philosophy. And banks would set up their internal compliance engines to rule out those forms of trading in order to not get dinged by a regulator and have their firms' names in the headlines. They will allocate less capital to taking these kinds of risky market-making trades, and then others will see the opportunity to fill that gap.

As Paul Volcker has predicted, and I think he's right, it's not that we will have illiquid markets forever. Within five, 10 or 15 years, others will come in and, as I said, that will introduce other unintended consequences.

## REFORM OF MONEY MARKETS

**Region:** After you gave your presentation on the Volcker rule, you were accused by some of favoring the financial industry. But it seems you've actually incurred the industry's *disfavor* with your ideas on reforming money market mutual funds—and for that matter, I think also with your recommendation that foreign exchange derivatives not be exempted from the Dodd-Frank swaps requirements.

Could you explain your concerns about these mutual funds, beginning with the role they played in the recent financial crisis? How do you propose they be reformed to prevent those risks in the future?

**Duffie:** As you know, these funds are treated essentially as cash investments by many investors, both retail and institutional. They are backed by short-term assets like commercial paper and repurchase agreements, which we might talk about later. When there are any concerns about the backing for those money market funds, investors have demonstrated, particularly after the failure of Lehman when one of these money market funds lost money ...

**Region:** The Reserve Fund.

**Duffie:** Yes, the Reserve Primary Fund. The institutional investors demonstrated that they have very twitchy fingers and will leave almost instantly. And they left not only that money market fund, but the entire prime money market fund complex. Institutional investors took out roughly 40 percent of their holdings in prime funds in the order of two weeks.

**Region:** Which was roughly how much money?

**Duffie:** About \$300 billion to \$400 billion. And that would have continued to the point of ultimate meltdown of the core of our financial system had the Treasury not stepped in to guarantee those money market funds. In a moment, we'll talk about the contagion effect of that meltdown. But just sticking to money market funds for now, economists such as myself who are concerned about this want to encourage the design of these funds so that they are not so prone to flight by institutional investors.

A few ways to do that have been proposed and are now being considered by the Securities and Exchange Commission,

which is the primary regulator for money market funds. One of those proposals is to put some backing behind the money market funds so that a claim to a one-dollar share isn't backed only by one dollar's worth of assets; it's backed by a dollar and a few pennies per share, or something like that. So, if those assets were to decline in value, there would still be a cushion, and there wouldn't be such a rush to redeem shares because it would be unlikely that cushion would be depleted. That's one way to treat this problem.

A second way to reduce this problem is to stop using a book accounting valuation of the fund assets that allows these shares to trade at one dollar apiece even if the market value of the assets is less than that.

**Region:** Instead, **mark to market?**

**Duffie:** Yes, mark to market. That's called a *variable* net asset value approach, which has gotten additional support recently. Some participants in the industry who had previously said that a variable net asset value is a complete nonstarter have now said we could deal with that.

**Region:** You and the Squam Lake Group proposed that in a working paper, I believe.

**Duffie:** Right. Those two measures that I just described, loss buffers and conversion to a variable net asset value, were the two alternate proposals that the Squam Lake Group, of which I'm a member, suggested back in January 2011. [See Baily et al. 2011.] We made a submission to the SEC on its proposed treatment of money market funds.

A third proposal, which has since come to the fore, is a redemption gate: If you have \$100 million invested in a money market fund, you may take out only, say, \$95 million at one go. There will be a holdback. If you have redeemed shares during a period of days before there are losses to the fund's assets, the losses could be taken out of your hold-

back. That would give you some pause before trying to be the first out of the gate. In any case, it would make it harder for the money market fund to crash and fail from a liquidity run.

**Region:** The analogy for a pre-FDIC [Federal Deposit Insurance Corp.] bank run would be the bank temporarily locking its doors.

**Duffie:** Instead of a bank holiday, it would be like a *partial* bank holiday. You can take out only 95 percent of your deposits, rather than 100 percent. That has the effect of a buffer because each investor in the money market fund is buffering his own or her own investment with the holdback. And that has gotten some support as well.

So now these three main ideas are floating around. The SEC has a serious issue about which of these, if any, to adopt. And it's getting some push-back not only from the industry, but even from some commissioners of the SEC. They are concerned—and I agree with them—that these measures might make money market funds sufficiently unattractive to investors that those investors would stop using them and use something else. That alternative might be better or might be worse; we don't know. It's an experiment that some are concerned we should not run. And, of course, those that sponsor money market funds would definitely not like to run that experiment.

I still believe that the Squam Lake proposals are good. But I think we also need to be aware that the money market fund industry could shrink significantly as a result of any of these proposals. We need to monitor where that liquidity next shows up. Because if it shows up, for example, in ordinary demand deposits in a bank, well, those are insured but only up to a minuscule amount relative to the investments of large institutional investors; \$250,000 is essentially nothing for a Pimco or a BlackRock or any large institutional investor.

So if a bank were to become of questionable solvency or liquidity, we could again see some run effects. Unsecured deposits are not backed by anything specific, as opposed to money market funds, which are backed by specific assets. So it is a difficult issue. I feel sympathy for the SEC. It has a tough decision to make.

## REFORMING REPO MARKETS

**Region:** As you know better than most, **repos**, or repurchase agreements, have become the main means for providing liquidity in the money market mutual funds. During the crisis, the repo market failed in a major way and policy-makers called for a significant reform of repo market infrastructure.

You've studied tri-party repo markets in particular and worked with the New York Fed in developing proposed changes to its infrastructure. Can you tell us why reform is needed in tri-party repo and why you consider automation so critical? And secondly, in your view, why did the private industry task force assigned responsibility for reform fail, such that the New York Fed felt it necessary to take the reins?

**Duffie:** That's a great question. Let's start with a description of what tri-party repo is. This concerns, basically, money market funds, which we just discussed—and other cash investors—that lend money

over very short terms, like one night, to large banks like JPMorgan, Goldman Sachs, Morgan Stanley and so on.

**Region:** What types of collateral are used to secure these loans?

**Duffie:** The large dealer banks secure these overnight loans with securities, typically Treasuries, agencies, corporate bonds and so on. Right now, the majority of it is Treasuries and agencies. Let's start with the legacy system, and then we'll talk about the makeover that has begun. Under the old system, these overnight loans would mature in the morning. The cash investors would be given back their cash plus interest, and the dealer banks would be given back their collateralizing securities.

But the dealer banks needed intraday financing for those securities. That is, between the morning and the afternoon when the next repurchase agreements are arranged, somebody had to finance those securities, and that was done by the tri-party clearing banks. These clearing banks also assist with the arrangement of the repo deals between the dealers and the cash investors.

**Region:** And there are effectively just two of them.

**Duffie:** Right, two: JPMorgan Chase and Bank of New York Mellon handle essen-

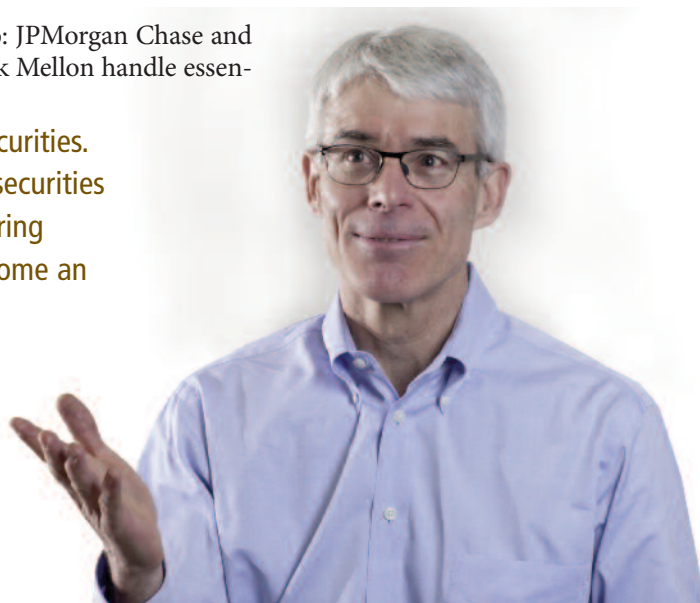
tially all U.S. tri-party deals. As part of this, they provide the credit to the dealer banks during the day. Toward the end of the day, a game of musical chairs would take place over which securities would be allocated as collateral to new repurchase agreements for the next day. All of those collateral allocations would get set up and then, at the end of the day, the switch would be hit and we'd have a new set of overnight repurchase agreements. The next day, the process would repeat.

This was not satisfactory, as revealed during the financial crisis when two of the large dealer banks, Bear Stearns and Lehman, were having difficulty convincing cash investors to line up and lend more money each successive day. The clearing banks became more risk averse about offering intraday credit.

We have to be a bit cautious here. I have a conflict of interest that I need to disclose. I'm a consultant to Lehman in a matter that is related to these issues. I'm under a nondisclosure agreement. Of course, I won't disclose anything here in violation of that agreement.

In any case, the clearing banks got to a point at which they might not agree to provide intraday credit to these banks. And if they had provided it, there was an unlikely but consequential event in

The dealer banks needed intraday financing for those securities. That was done by the tri-party clearing banks. ... If the securities were of questionable value or if the leverage at the clearing banks became too large, absorbing all of that might become an issue. Maybe they would say, "No, we won't offer you intraday loans." That could immediately snuff out one of these dealer banks ... absent emergency lender-of-last-resort treatment by the Fed.





which they did provide credit and the dealer would fail during the day. The clearing bank would be left on the hook to deal with all of the collateral. That should normally not be fatal, because the collateral was there to back the loan. But the amounts of these intraday loans from the clearing banks at that time exceeded \$200 billion apiece for some of these dealers. Now they're still over \$100 billion apiece. That's a lot of money.

**Region:** Potentially unsecured.

**Duffie:** Well, it *is* secured, by securities. But if the securities, some of them, were of questionable value or if the leverage at the clearing banks became too large, absorbing all of that collateral onto their balance sheets might become an issue for them. Maybe they would say, "No, we won't offer you intraday loans." That could immediately snuff out one of these dealer banks because there's no way they could survive if they couldn't finance their securities for the next day. For operational reasons, a dealer cannot switch to a new clearing bank on short notice. Absent emergency lender-of-last-resort treatment by the Fed, this would basi-

cally be the end of whatever dealer bank was on the wrong end of this.

Lehman's portfolio of repurchase agreements was shrinking dramatically through that period as it tried to unwind its positions because of concerns over whether it could, in fact, finance them. Lehman did go bankrupt, as we all know. Lehman's broker-dealer subsidiary kept running for another few days, relying heavily on the Fed for financing of its securities.

## AUTOMATING CLEARANCE

**Region:** In your proposal on reform of tri-party repo infrastructure, you and your co-authors emphasize the need for automated clearance. How would that help?

**Duffie:** One way the system would run better is if the tri-party banks were able to pass the baton from one cash lender to another cash lender without ever being involved as a creditor themselves. That can be done. It's essentially what's being done in Europe, with minor exceptions.

But doing that or even getting close to that requires very slick operational capability, including very good information technology. And it requires enough

*trust* by dealers that the available technology will allocate collateral efficiently to the various loans, so that the dealers will stand back and just allow the information technology to take over and automatically allocate collateral out of the maturing repurchase agreements and into the new repurchase agreements without the clearing bank having to provide interim credit.

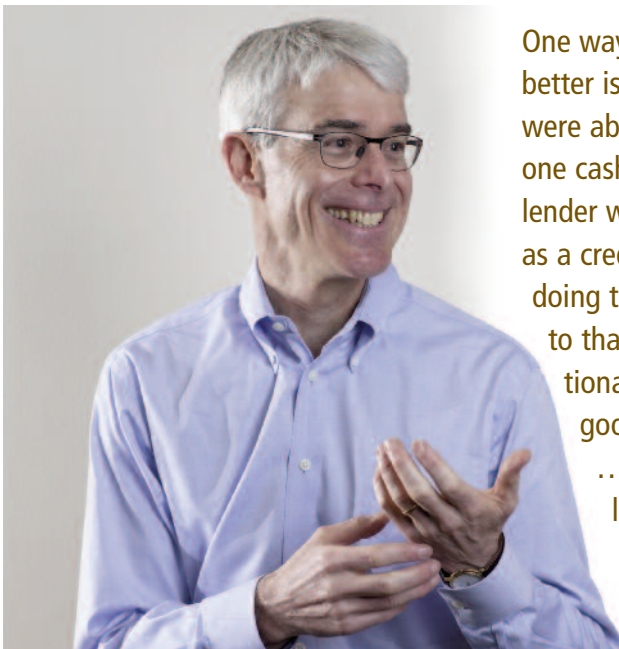
**Region:** So it speeds the process, and it also removes discretion.

**Duffie:** It removes discretion in a number of ways. It removes the discretion of the dealer who might not trust the efficiency of the information technology and wants to interfere in the process by saying, "No, no, we didn't want those securities into *those* loans. We wanted them into *these* loans because that's more efficient." If the information technology is very good, trustworthy and robust, they could just stand back and let that happen.

Moreover, the dealers might say, "Look, we also want the ability to quickly extract some particular Treasuries or agencies that a customer would like to buy. We'd like the ability to extract those from the pool of collateral backing some loans and replace them easily with other stuff."

You need good information technology to handle all of that efficiently. This sort of technology exists right now, but it's basically legacy technology. Imagine baling wire, Scotch tape and staples. It's going OK but it's not gotten to the point where the New York Fed as the primary regulator of this repurchase agreement market is satisfied that it's robust to the default of a dealer. Therefore, the New York Fed, in effect, pulled the plug on the industry project because it was going too slowly toward a satisfactory removal of the clearing banks from the credit provision in this market.

**Region:** You've pointed out that European tri-party repo is more efficient, more automated. I can't believe



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their technology is that much better. Is their market smaller?

**Duffie:** In fact, their technology is somewhat better because they started later. When the eurozone came into being in 2001, they had the advantage of not having legacy technology because there was no legacy eurozone. They invested in very good infrastructure and good technology. And they have the advantage you just described of having a smaller market.

**Region:** Can you give a sense of the relative scale?

**Duffie:** Well, in Europe, the banks do a lot of the financing of European corporations directly with bank loans. Securities are used less. Moreover, in Europe, securities are often held on bank balance sheets with general financing, rather than on broker-dealer balance sheets, where the cheapest financing is through repo. The corporate bond market in total is much smaller, perhaps about half the size. At the end of 2010, the European tri-party repo market was only about one-fourth the size of the U.S. market, based on data from the International Capital Market Association.

## EUROZONE

**Region:** What is your sense of the fundamental problems in the eurozone? It's not repro markets, since apparently they're better than ours. It's not **credit default swap** speculation—you've said elsewhere that that's not really the issue in Greece. But what then would you propose to solve the fundamental problems in the eurozone? I think you said recently that Europe will "muddle through." That's pretty tempered optimism.

**Duffie:** Yes, I'm afraid that a good scenario, looking forward from this point, is that over time they're able to recapitalize their banking system and to put some

The tri-party clearing banks are highly connected, and we simply could not survive the failure of probably either of those two large clearing banks without an extreme dislocation in financial markets, with consequential macroeconomic losses. That's not a good situation. We should try to arrange for these tri-party clearing services to be provided by a dedicated utility, a regulated monopoly.

firewalls around peripheral sovereign defaults, so they will have time to eventually restructure the eurozone itself.

The recent eurozone banking and sovereign credit crises are partly symptomatic of the very structure of the eurozone that was baked in at the turn of the century, when it was agreed to have a monetary union but not a fiscal union.

Comparisons are made with the United States, whose states also have a monetary union but not a fiscal union. These are not apt comparisons. These European countries are sovereigns; they are not constitutionally required to balance budgets. They rely on the euro as a common currency, but can be overly reliant on the cheap financing available through a stable, large currency zone and can get themselves into trouble. And some of them have done that.

Now there's a damned-if-you-do and damned-if-you-don't problem. The larger, wealthier countries such as Germany and the Netherlands are in a position where they are able to forestall the deepest crises caused by banking problems and peripheral country defaults by putting more of their capital into play. That may simply discourage weaker sovereigns from taking care of their own fiscal problems and kick the can down the road. They may have to do it again.

On the other hand, if they don't contribute significant capital to stop these short-term banking and sovereign defaults from occurring, at least disruptively, then Europe could be thrown into a very significant financial crisis and associated deep recession.

So the "muddle through" scenario is some of this and some of that. Each time the richer European countries give up a

little bit more capital, they demand a bit more financial discipline. It's going to be a long, hard road. There are no simple fixes to this.

I would agree with [Harvard University's] Ken Rogoff, for example, on the deeper structural problems that they're facing. They'll eventually come, I think, toward a fiscal union of some sort, possibly with some departing members or at least some taking "sabbaticals." I think Ken used that term.

Eventually, they'll probably get something closer to what they want. But in the meantime, this is harming their growth because the banking system is not vibrant enough to provide a lot of credit, and investors are scared about putting much money at risk right now, with the uncertainty about the eurozone.

**Region:** It's either short-term pain or long-term pain.

**Duffie:** Yes, "muddle through." If they can manage to do that, that's good news. What we *don't* want is a sudden banking crisis, which I was worried about last fall until these giant LTROs [long-term refinancing operations] came out of the ECB. I'm referring to long-term refinancing operations by which the European Central Bank, in two rounds now, has provided close to a trillion euros of liquidity to banks, secured by a very wide range of collateral for three years. The terms are very generous to the banks.

Despite the headlines these days, Greece is not going to be a big problem for Europe. In fits and starts, [Greece is] going to default again; I think that's pretty certain. But [it's] not going to



cause the rest of Europe a deep, financial crisis in itself. The precedents that are being set, though, for Greece are important when handling other countries that could get into trouble in the future.

## THE ROOTS OF SYSTEMIC RISK

**Region:** Perhaps now we could discuss the roots of systemic risk in financial markets. Many analysts of the crisis have emphasized interconnectedness. And certainly that's embodied in Dodd-Frank, that interconnections among systemically important financial institutions need to be addressed in order to mitigate future systemic risk.

But a number of observers like Peter Wallison of the American Enterprise Institute and John Cochrane at the University of Chicago have argued that the interconnectedness theory is flawed. They suggest that it's really a "common shock" to the system that causes systemwide stress: that a decrease in an asset that's widely held, like real estate, is what led to the crisis.

You've done a great deal of research on correlated default, information transmission in financial markets, liquidity in repo and other markets, the mechanics of bank failure. Do you tend to lean toward the interconnectedness perspective or the common shock theory?

**Duffie:** John and Peter are both good friends. I think there are elements of their view that are correct. That is, there were relatively few instances in this crisis in which investor B defaulted because they didn't get paid back by investor A.

Nevertheless, there is a substantial amount of connectedness in financial markets through such things as the potential for a fire sale. So if a bank fails and needs to sell its securities in a hurry, the prices of those will likely go down: That could cause a contagion effect for other owners of the same assets.

Then there are forms of interconnectedness that didn't actually result in dominoes during the crisis *because* of



We're looking at years of work to improve the plumbing, the infrastructure. ... If not well designed, the plumbing can get broken in any kind of financial crisis if the shocks are big enough. Then the financial system will no longer function as it's supposed to, and we'll have recession or possibly worse.

government interventions. For example, when AIG was on death's door, a number of very large banks were exposed to AIG on credit derivatives and would have been stressed considerably had it not been for the action of the government to, in effect, bail out AIG.

Similarly, as we discussed a few minutes ago, money market funds were in the process of melting down. Let's trace through what would have happened had the Treasury not guaranteed those funds. Without that intervention, it's conceivable—in fact, I would say even *likely*—that money market funds would have withdrawn financing so rapidly from the dealer banks through the tri-party repo market that the survival of some dealers would have been under exceptional pressure. That's because, unfortunately, they were overly reliant on short-term loans obtained from money market funds through the repurchase agreement market.

That is a form of connectedness that doesn't sound exactly like the domino story but does need to be addressed, in my view.

And that's only one example. There are others. For example, **central clearing**

**counterparties** [CCPs] are now going to be a big part of our new financial system. They are *very* connected to some large market participants.

The tri-party clearing banks are *highly* connected, and we simply could not survive the failure of probably either of those two large clearing banks without an extreme dislocation in financial markets, with consequential macroeconomic losses.

So if you take, for example, the Bank of New York Mellon, it really *is* too interconnected to fail, at the moment. And that's not a good situation. We should try to arrange for these tri-party clearing services to be provided by a dedicated utility, a regulated monopoly, with a regulated rate of return that's high enough to allow them to invest in the automation that I described earlier. A dedicated utility would not have much moral hazard. It would not have the legal scope for investing in other kinds of risky things, *only* doing tri-party repo—in light of the interconnectedness problem.

## FINANCIAL PLUMBING

**Region:** This leads to the paper you have drafted for the Fed's conference later

this month. [See Duffie 2012.]

You mention in that paper that some progress has been made, especially in terms of capital and liquidity requirements for regulated banks. But you also say that much needs to be done to address the plumbing of the financial infrastructure.

Then you cite six things, some of which we just discussed. They range from broadening access to liquidity in emergencies to lender-of-last-resort facilities, to engaging in a “deep forensic analysis” of prime brokerage weakness during the Lehman collapse.

And then you touch upon tri-party repo markets, wholesale lenders that might gain prominence if money market funds are reformed and therefore shrink, pursuing cross-jurisdictional supervision of CCPs and developing plans for their failure, and including foreign exchange derivatives in swap requirements.

It’s a daunting amount of work. Each one of those is a major effort.

**Duffie:** Yes, it’s a big project.

**Region:** Indeed, and we haven’t even gotten the Volcker rule implemented yet—that’ll be a while—let alone, tri-party market reform. Well, could you tell us the key principles that underlie these efforts, given what you said about systemic risk and its sources?

A fundamental objective seems to be a desire to design and regulate major parts of the infrastructure that, as you put it, are too important to fail. Regulated utilities, for example.

**Duffie:** Correct. And there has been a lot of progress made, but I *do* feel that we’re looking at years of work to improve the plumbing, the infrastructure. And what I mean by that are institutional features of how our financial markets work that can’t be adjusted in the short run by discretionary behavior. They’re just there or they’re not. It’s a pipe that exists or it’s a pipe that’s not there. And if those pipes are too small or too fragile and therefore

break, the ability of the financial system to serve its function in the macroeconomy—to provide ultimate borrowers with cash from ultimate lenders, to transfer risk through the financial system from those least equipped to bear it to those most equipped to bear it, to get capital to corporations—those basic functions which allow and promote economic growth could be harmed if that plumbing is broken.

If not well designed, the plumbing can get broken in any kind of financial crisis if the shocks are big enough. It doesn’t matter if it’s a subprime mortgage crisis or a eurozone sovereign debt crisis. If you get a big pulse of risk that has to go through the financial system and it can’t make it through one of these pipes or valves without breaking it, then the financial system will no longer function as it’s supposed to and we’ll have recession or possibly worse.

None of these risks that you deftly summarized is *likely* to occur in the next few years, but we shouldn’t hesitate, in my view, to invest in a safer and sounder financial system, with the thought in mind that some time in the next 10, 20, 30 or 40 years, we could have another major financial crisis. Or, that by investing in this manner, we can forestall some of those financial crises. Preparedness is important. The cost/benefit analysis, while difficult to do, would probably bear out those recommendations.

## MEASURING SYSTEMIC RISK

**Region:** You have also proposed a very pragmatic, plumbing sort of strategy for measuring systemic risk: the 10×10×10 proposal. Would you summarize that for us?

**Duffie:** Sure. Again, the philosophy is that our financial system is an interconnected system of financial entities, whether they’re market utilities or dealer banks or large investors, hedge funds and the like. Until the last few years, our primary approach to monitoring the

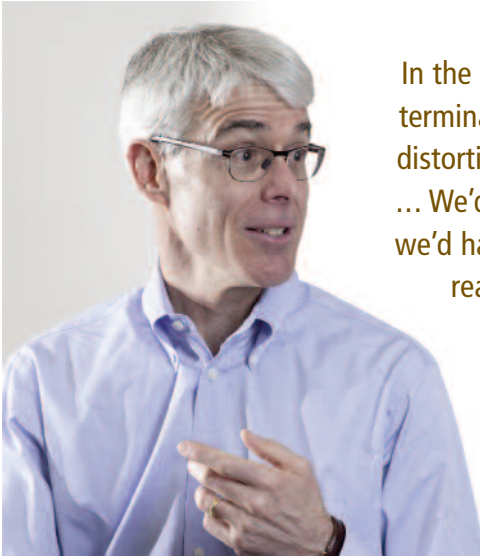
“How much is enough?” The capital requirements of large banks going into the last financial crisis were generally not enough. I think even the banks would agree. ... So “more” is an easier answer than coming up with an exact figure. I would err on the safe side. ... The cost of getting it too high is less, in my view, than the cost of getting it too low.

quality of our financial system insofar as safety and soundness, has been to look at each of the players in the system and analyze whether they’re robust enough—especially if they’re systemically important—to withstand the kinds of shocks to which they might be subjected.

I think we have gotten to the point at which we need to now consider not just the *nodes* in the network, but the *links* that connect them, and to begin to monitor the financial system as though it’s a network. In my proposal, we would have the most systemically important firms report to their regulator their exposures to a range of shocks *not only to themselves* (for example, what would a 50 percent reduction in the value of the stock market do to their balance sheet), *but also* how much gain or loss they would experience relative to each of their largest counterparties for that shock.

So I call this “10×10×10” (not that 10 is necessarily the right number) because there would be, let’s say, 10 large, systemically important reporting firms, and for each of, let’s say, 10 crisis scenarios, they would report their own gain or loss *and* their gain or loss relative to each of their 10 largest counterparties for that shock.

They might not be the same counterparties for one shock as for another. And some of those counterparties



In the ideal world, we'd all be sitting at our terminals watching for every possible price distortion. ... We'd all jump in like piranhas. ... We'd drive out those price distortions and we'd have very efficient markets. But in the real world, you know, we all have other things to do, and we're not paying attention. So we do rely on providers of immediacy, and we should expect that prices are going to be inefficient in the short run and more volatile.

might not be among the 10 systemically important firms. They could be hedge funds outside of the reporting system or insurance companies or sovereigns or quasi-sovereigns.

By monitoring those links, we will understand where the hotspots are, what scenarios give the greatest concern. It would allow us to ask supervisory questions. We'll understand which counterparties or creditors are most exposed to certain kinds of shocks and to whom they're most exposed. A supervisory conversation that a regulator might have with a large bank could include the question, "Did you realize that the hedge fund with which you

## More About Darrell Duffie

### Current Position

Dean Witter Distinguished Professor of Finance, Graduate School of Business, Stanford University; Coulter Family Faculty Fellow, 2011-12; on faculty since 1984

### Professional Service

Member, Scientific Council, Duisenberg Institute, since 2010

Member, Scientific Committee, Swiss Finance Institute, since 2010

Member, Council, Society of Financial Econometrics, since 2009

Senior Fellow, Stanford Institute of Economic Policy Research, since 2009

Member, Squam Lake Working Group, since 2008

Member, Working Group on Global markets, Hoover Institution, since 2008

Member, Board of Directors, Pacific Institute of Mathematical Sciences, since 2007

Member of the Financial Advisory Roundtable, Federal Reserve Bank of New York, since 2006

Research Associate, National Bureau of Economic Research, since 1997

### Honors and Awards

President, American Finance Association, 2009-10

Minerva Foundation Lecturer, Columbia University, 2011

Tinbergen Institute Finance Lecturer, Duisenberg Institute, 2010

Elected fellow, American Academy of Arts and Sciences, 2007

Clarendon Lecturer in Finance, Oxford University, 2004

Financial Engineer of the Year, International Association of Financial Engineering, 2003

Distinguished Teacher, Doctoral Program, Graduate School of Business, Stanford University, 2003

NYSE Prize for Equity Research, Western Finance Association, 2002

Fellow and Member of the Council, Econometric Society, since 1997

### Publications

Author of, among other books, *Dark Markets*, Princeton University Press, 2012; *Measuring Corporate Default Risk*, Oxford University Press, 2011; *How Big Banks Fail—And What to Do About It*, Princeton University Press, 2010; *Dynamic Asset Pricing Theory*, Princeton University Press, 3rd edition, 2001. Published extensively in academic journals and elsewhere, with research on security markets, risk management, asset pricing theory and financial market innovation.

### Education

Stanford University, Ph.D., engineering economic systems, 1984

University of New England (Australia), master of economics (economic statistics), 1980

University of New Brunswick (Canada), B.S. in civil engineering, 1975



have this large position also has large positions in the same direction with several other large banks? Does that give you any concern about the liquidity impact if this hedge fund had to unwind its position, and you and the other large banks in this asset class would have to unwind or sell collateral associated with that kind of a scenario?"

Of course, the information would need to be treated very confidentially at a disaggregated level. But some of the information could be given to the public at a more aggregated level so that the public could also consider managing or repricing these risks in a way that would improve the health of the financial system. We wouldn't want to panic anyone, though, by suddenly revealing that a certain financial institution had extreme exposures to some scenario.

**Region:** Essentially, this is sort of an "enhanced" stress test?

**Duffie:** It's basically a network version of a stress test. From private conversations, I think certain regulators are already doing some of this.

At some point, we may hear more about what regulators are doing in this area. I've had many discussions about this not only with U.S. regulators, but in the United Kingdom, Switzerland and the European Central Bank, among others. It's much more effective if it's done on a global basis because, of course, the network doesn't stop at the boundaries of the United States.

## SQUAM LAKE AND CAPITAL REQUIREMENTS

**Region:** The Squam Lake report recommended setting high capital requirements to mitigate risk of systemically important financial institutions. You've echoed that recommendation in your Volcker presentation and elsewhere in your work. Two questions occur. First, how do you set the right level of capital? That is, what's the *right* ratio of regula-

tory capital to assets? And second, how do you know that firms won't respond to higher capital requirements by actually taking greater risks as they seek profit on the remaining, nonregulatory capital?

**Duffie:** The first question is by far the harder one, which is, "How much is enough?" And so far, I haven't seen any academic or regulatory studies that have a strong conceptual foundation for saying 8 percent or 4 percent or 12 percent is enough. We know that, as measured, the capital requirements of large banks going into the last financial crisis were generally not enough. I think even the banks would agree. While each individual bank might say that *it* was fine, they'd also say that the banking system in general was undercapitalized. And certainly that view of the European banking system currently prevails.

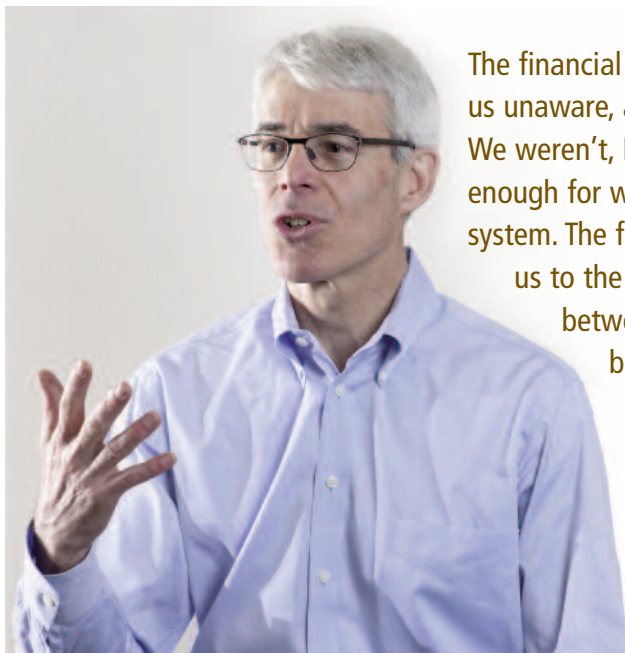
So "more" is an easier answer than coming up with an exact figure for how much. The Basel III requirements unfortunately are going to be delayed, although because of the eurozone crisis, they're being accelerated there somewhat. But they're a step in the right direction.

I would err on the safe side. The Swiss

standard, which is roughly double the capital requirements under Basel III, is a good example. One concern is that if each country were to set a standard on its own, then none would have sufficient incentive because banking might migrate to another banking center; there would be a loss of competitiveness. Or possibly even worse: a migration of bad risk or even an increase in risk. So it should be done in a coordinated fashion. I think the Basel III process is a good framework in which to do that.

The cost of getting it too high (within reasonable ranges) is less, in my view, than the cost of getting it too low. Some of the banks have suggested that raising capital requirements would significantly reduce the appetite for banks to make loans and provide other banking services. I haven't seen any strong research to justify that view.

It would likely harm the position of the shareholders of those banks because they benefit from leverage. That's a well-understood idea. They have an option to take gains, but if things get bad enough, they have no further losses because of their limited liability. So shareholders would suffer with higher capital requirements. But I am not con-



The financial crisis caught almost all of us unaware, and I am including myself. We weren't, I think, looking broadly enough for weaknesses in the financial system. The financial crisis has alerted us to the important connection between asset market behavior, banking and the macro-economy.

vinced that banking activities would be reduced dramatically by higher capital requirements. Basel III is certainly not overly aggressive in my view.

**Region:** And how do you know that firms won't respond to higher capital requirements by taking greater risk with nonregulatory capital?

**Duffie:** I don't believe, by the way, in the idea that capital should be just gross assets times some fraction. I think you do want to have risk weights. After all, derivatives, for example, require almost no investment in assets, but they can have a tremendous amount of risk per dollar up front. So I think you do need to tune the capital to the type of risk that's taken. If that's done in a judicious way, the opportunity to try to make up with extra risk for additional pressure to create returns for investors, I think, will be forestalled. The risk weights are very important. And I would point not only to the capital but also particularly to the liquidity, which in all of the discussions we had earlier was a key element. It isn't just whether you are solvent. It is also whether you are able to get enough cash on short notice to meet your obligations, say, overnight.

### "IGNORANCE IS BLISS"?

**Region:** In his recent presidential address to the Econometric Society, Bengt Holmstrom suggested that there may be a certain level of desirable opacity in financial markets, that in some situations a *lack* of complete transparency is vital for liquidity.

Given your research on information transmission in financial markets and the effect of search and investor inattention on asset pricing, what are your thoughts about this idea?

**Duffie:** Well, as Bengt, my friend, himself points out, that is true only so long as the quality of the opaque asset is not brought

into question. So, for example, with a **collateralized debt obligation**, as long as there are no concerns, it's wonderful that investors who rely on these for collateral or as a source of risk taking in return for a yield—as long as they *don't* become concerned about the quality of those assets, they won't need to invest time in understanding the incredibly complicated prospectuses of these collateralized debt obligation deals.

I've actually examined them for some research with Nicolae Gârleanu—they are *really* hard to sort out. It would be unfortunate if investors, each individually, had to try to figure them out in order to judge whether there were problems in them. Ideally, that's why investors delegated the monitoring of some of these more complex instruments to rating agencies, but the rating agencies did not get this right either. I have been on the board of directors of Moody's Corporation since the month after Lehman failed. The market for relatively complex structured credit products has nearly disappeared.

We do benefit from the opaqueness of some assets, but only so long as it is commonly agreed that the asset is safe. But we can get into a situation where all of a sudden the quality of the asset is called into question. And then we get extreme adverse selection; almost no one wants to touch the asset. What was your friend when you viewed the asset as safe is now your enemy and possibly becomes a source of market illiquidity. That's exactly what led to the TARP legislation in Congress. The original idea of that TARP deal, despite its ultimate application, was to get around the opacity of some of these complicated assets by having the government buy them and absorb the risk.

### ASSET PRICES AND CAPITAL FLOWS

**Region:** In your presidential address to the American Finance Association, you

examined different impediments to capital flow and their effect on asset prices. You look at search frictions (such as those due to market opaqueness) and limits on intermediation (like inventory imbalances, including those during the recent crisis), and then you focus on investor inattentiveness—including a striking Tiger Woods anecdote that I hadn't heard before.<sup>1</sup>

You've studied investor inattention for over 20 years, and in your address, you point out that it has substantial influence on price dynamics by thinning markets. Would you briefly explain this effect, and tell us about the relative contributions of each of these factors—search frictions, limited intermediation and investor inattention—to price dynamics?

**Duffie:** Sure, and these ideas also intersect with what we discussed earlier, with respect to the Volcker rule. The first really interesting research in this area was by Merton Miller and Sandy Grossman, in 1988 when they pointed out that not all investors are present and participating at all times in financial markets, buying and selling whatever assets others are bringing to the market. [See Grossman and Miller 1988.]

They pointed out that *because* of that inattention by many investors, we rely on professional investors called market makers or liquidity providers to be there and to absorb these sudden demands for immediacy by those who feel they must sell or must buy quickly. Of course, these market makers and other liquidity providers are not going to take the associated risk with almost no reward; they're going to require a price concession. And the fewer are the investors that are actively participating in a market on a given day, the more the price concession would have to be for liquidity providers to absorb that risk.

We can imagine the sale of a large block of stock. Only a few professional liquidity providers, such as market makers, are there to absorb the block onto

their balance sheets. Everyone else is too small to take much, or is not paying attention on that day. The liquidity providers will each have to take a large fraction of that large block. So investor inattention means large price concessions for large blocks of stock or other assets, such as corporate bonds or Treasuries. Market makers will eventually lay off these positions over time at a profit to themselves.

The greater the inattention of the ordinary investor, the greater are these swings in prices caused by price concessions at times of liquidity shocks of this type, and the greater are the resulting long-term reversals in price over time. I've been looking at this issue for some time.

After Miller and Grossman, probably the next milestone in this literature is a paper by Markus Brunnermeier and Lasse Pedersen in which they describe what they called market liquidity and funding liquidity. [See Brunnermeier and Pedersen 2008.] They made that distinction because the ability of market makers to obtain financing for themselves, their funding liquidity, will determine in part the market liquidity of assets. If market makers are not well capitalized or have small risk limits or because regulations such as the Volcker rule are not able to absorb large chunks of risk on short notice, then the liquidity of the corresponding assets will be less.

In the ideal world, we'd all be sitting at our terminals watching for every possible price distortion caused by demands for immediacy. We'd all jump in like piranhas to grab that, we'd drive out those price distortions and we'd have very efficient markets. But in the real world, you know, we all have other things to do, whether it's teaching or interviewing economists or whatever, and we're not paying attention.

So we *do* rely on providers of immediacy, and we *should* expect that prices are going to be inefficient in the short run and more volatile than they would be in a perfectly efficient market, but in

a natural way. I have been studying markets displaying that kind of price behavior to determine in part how much inattention there is or how much search is necessary to find a suitable counterparty for your trade.

## FINANCE AND MACRO

**Region:** Let me ask you about finance and macroeconomics. The recent crisis has certainly brought greater prominence to financial economics. But for decades, up until the 1960s perhaps, financial economics was given little recognition in macroeconomic theory. The Nobel awards first honored it in 1990 with the prize to Markowitz, Miller and Sharpe. And in 1997, to Merton and Scholes.

But after the crisis, is enough being done to integrate financial economics into broader macroeconomic scholarship?

**Duffie:** Well, I would say it's by far the largest growth area in Ph.D. dissertations that I've seen in a long time.

**Region:** And not just at Stanford?

**Duffie:** No, not just here. Prior to the financial crisis, there was a surge of interest in finance in areas like corporate governance, compensation, behavioral finance and many other important areas. But the financial crisis caught almost all of us unaware, and I am including myself. We weren't, I think, looking broadly enough for weaknesses in the financial system. The financial crisis has alerted us to the important connection between asset market behavior, banking and the macroeconomy.

The importance of mechanisms like collateral for loans, for example. That's probably one of the most frequently researched topics now for Ph.D. students in the general area of finance and macro. Before the financial crisis, the topic was almost exotic. So definitely the agenda has changed. The integration

of macro and finance has been a big improvement in my view.

**Region:** Thank you very much.

**Duffie:** It's been a great pleasure. **R**

—*Douglas Clement*  
March 7, 2012



## Endnote

<sup>1</sup> In his American Finance Association presidential address, Duffie refers to a *Wall Street Journal* article (Feb. 19, 2010) that reported, “Investors took time out from trading to watch [Tiger] Woods apologize for his marital infidelity. ... New York Stock Exchange volume fell to about 1 million shares, the lowest level of the day at the time in the minute Woods began a televised speech. ... Trading shot to about 6 million when the speech ended.” (Patterson, Michael, and Eric Martin, 2010, Wall Street takes break for Tiger Woods’ apology: Chart of day, Bloomberg)

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## Glossary

### Basel III

The Basel III accords are international regulatory standards adopted in 2010-11 by members of the Basel Committee on Banking Supervision. The standards focus on capital requirements, stress testing and liquidity risk, and are intended to improve the banking sector’s ability to absorb shocks, improve risk management and increase transparency. The reforms target both bank-level regulation and systemwide risk.

### Central clearing counterparty (CCP)

The Dodd-Frank Act requires that standard derivatives traded by major market participants be cleared through a regulated CCP that will stand between counterparties trading over-the-counter derivatives. (“Over-the-counter” refers to securities transactions through broker-dealer networks, rather than large exchanges like the New York Stock Exchange or Nasdaq. A derivative is a financial instrument in which value is based indirectly on other assets, like commodity futures, stock options and risk swaps. It’s basically a contract between buyer and seller that specifies payment terms based on the underlying asset’s value at a specific date.)

The idea of a CCP is to buffer each counterparty against potential default by the other, thereby mitigating systemic risk due to one default propagating subsequent defaults. CCPs might also increase transaction efficiency.

### Collateralized debt obligation

CDOs are investor securities backed by a pool of loans, bonds or other assets. Like other asset-backed securities, they are usually divided into “tranches,” or subsections, by maturity date and risk level, with riskier tranches paying higher rates of return. While CDOs were initially promoted as a means of reducing risk through diversification, many analysts suggest that their complexity and lack of regulatory oversight instead raised systemic risk. CDO volume increased dramatically in the early 2000s, but the market collapsed during the recent financial crisis.

### Credit default swap (CDS)

A CDS is essentially an insurance contract that allows a buyer and seller to trade risk. It compensates the buyer

against losses in the event of a loan default or other credit event. The seller profits by charging a premium for such protection.

For example, a CDS would be an agreement between parties A and B regarding the potential default of company C. (Although recent CDS news has involved potential default on the sovereign debt of nations, rather than companies.) Party A wants insurance against C's default—perhaps it has invested in C—and is willing to pay party B a stream of payments, similar to paying insurance premiums, for that insurance. If C does default, B will pay a specified amount to A. If C doesn't default, however, B retains the CDS payment stream, just as a health insurance company wouldn't return premiums to a healthy customer.

### Mark to market

Mark to market is setting the price of an asset or liability to reflect current market valuation, rather than historical book value. Often referred to as “fair value” accounting, marking to market seeks to provide an accurate picture of existing (or recent) market conditions, in contrast to cost accounting based on transactions from the more distant past; book value established through cost accounting may prove inaccurate if asset values change quickly and significantly. Thus, marking to market may provide greater real-time accuracy (assuming relevant markets are transparent and prices readily accessible), particularly during financial crises.

### Metrics

The proposed rules for implementation of the Volcker rule provide a set of metrics (or measures) that would enable regulators to evaluate whether banks are in compliance with the Volcker rule. Further, the rules would enact sanctions for significant increases in risk associated with market making or significant profits due to changes in price (as opposed to profits due to revenues from bid-to-ask price spreads, which are permitted by the Volcker rule).

These regulatory metrics are technical measures of factors such as bank risk and revenue-to-risk ratios, including Risk and Position Limits, Value at Risk (VaR), Stress VaR and Risk Factor Sensitivities. VaR, as one example, measures statistically the adverse impact that potential

changes in market rates and prices could have on a bank's portfolio value.

### Proprietary trading

Proprietary trading is a term used to describe a bank or other financial institution seeking profit through speculative trading with its own funds rather than by earning commissions through processing trades for its clients. The Volcker rule would prohibit this proprietary trading because it may encourage undue risk taking by financial institutions that are insured explicitly or implicitly by government, and thereby raise systemic risk. The rule does, however, permit certain exceptions to this prohibition, including those related to “market making”—that is, trading to provide asset immediacy or liquidity to facilitate investor activity.

### Repo

Short for (sale and) repurchase agreement, a repo is a contract that combines the sale of a security with an agreement to repurchase the same security at a specified price at the end of the contract period. Effectively, it's a secured or collateralized loan—a loan of cash against a security offered as collateral.

“Tri-party repo” is a form of repo in which a third party—a clearing bank—provides clearing and settlement services to the cash investor and collateral provider. If the investor and provider instead engage directly with one another, rather than through a clearing bank, it is called a “bilateral repo.” In the 2000s, the tri-party repo market became the primary funding source for securities dealers. During the financial crisis, the tri-party repo market experienced little change in “haircuts,” or percentage discounts between cash deposit and security collateral; by contrast, haircuts increased dramatically in the bilateral repo market.