

SOLVING THE PRESENT CRISIS AND MANAGING THE LEVERAGE CYCLE

1. INTRODUCTION

The present crisis is the bottom of a leverage cycle. Understanding that tells us what to do, in what order, and with what sense of urgency. Public authorities have acted aggressively, but because their actions were not rooted in (or explained with reference to) a solid understanding of the causes of our present distress, we have started in the wrong place and paid insufficient attention and devoted insufficient resources to matters—most notably, the still-growing tidal wave of foreclosures and the sudden deleveraging of the financial system—that should have been first on the agenda.

In short and simple terms, by leverage cycle I mean this. There are times when leverage is so high that people and institutions can buy many assets with very little money down and times when leverage is so low that buyers must have all or nearly all of the money in hand to purchase those very same assets. When leverage is loose, asset prices go up because buyers can get easy credit and spend more. Similarly, when leverage is highly constrained, that is, when credit is very difficult to obtain, prices plummet. This is what happened in real estate and what happened in the financial markets. Governments have long monitored and adjusted interest rates in an attempt to ensure that credit did not freeze up and thereby threaten the economic stability of a nation. However, leverage

(equivalently, collateral rates) must also be monitored and adjusted if we are to avoid the destruction that the tail end of an outsized leverage cycle can bring.

Economists and the public have often spoken of tight credit markets, meaning something more than high interest rates, but without precisely specifying or quantifying exactly what they meant. A decade ago, I showed that the collateral rate, or leverage, is an *equilibrium* variable distinct from the interest rate.¹ The collateral rate is the value of collateral that must be pledged to guarantee one dollar of loan. Today, many businesses and ordinary people are willing to agree to pay bank interest rates, but they cannot get loans because they do not have the collateral to put down to convince the banks their loan will be safe.

Huge moves in collateral rates, which I have called “the leverage cycle,” are a recurring phenomenon in American financial history.² The steps we must take at the end of the current cycle emerge from understanding what makes a leverage cycle swing up, sometimes to dizzying extremes, and then come crashing down, often with devastating consequences.

¹ Geanakoplos (1997, 2003).

² The history of leverage is still being written, because until recently it was not a variable that was explicitly monitored. But work by Adrian and Shin (forthcoming) and others is helping to restore the historical record.

John Geanakoplos is the James Tobin Professor of Economics at Yale University, an external professor at the Santa Fe Institute, and a partner in Ellington Capital Management, which trades primarily in mortgage securities. john.geanakoplos@yale.edu

On October 3, 2008, the author presented to Ben Bernanke and the Federal Reserve Board of Governors the substance of this paper’s proposal. The author is grateful to Susan Koniak for very helpful and detailed comments and advice, as well as for allowing him to use material from their two *New York Times* editorials. He is also appreciative of the very fine comments received from Asani Sarkar and two referees, and is deeply indebted to Joseph Tracy for editorial advice far beyond the call of duty, encompassing tone, style, and content. Needless to say, neither he nor anyone else is responsible for, or even necessarily in agreement with, the views expressed here. The views expressed are those of the author and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

All leverage cycles end with: 1) bad news that creates uncertainty and disagreement, 2) sharply increasing collateral rates, and 3) losses and bankruptcies among the leveraged optimists. These three factors reinforce and feed back on each other. In particular, what begins as uncertainty about exogenous events creates uncertainty about endogenous events, like how far prices will fall or who will go bankrupt, which leads to further tightening of collateral, and thus further price declines and so on. In the aftermath of the crisis, we always see depressed asset prices, reduced economic activity, and a collection of agents that are not yet bankrupt but hovering near insolvency. How long the aftermath persists depends on how deep the crisis was and how effective government intervention is.

Once the crisis has started, the thematic solution is to reverse the three symptoms of the crisis: contain the bad news, intervene to bring down margins, and carefully inject “optimistic” equity back into the system. As with most difficult problems, a multi-pronged approach is generally the most successful. To be successful, any government plan must respect all three remedial prongs, and their order. The unusual government interventions in this cycle have in many respects been quite successful in averting a disaster—precisely, I would argue, because they embodied some of the novel leverage cycle principles I describe here. The effectiveness of the interventions could be increased even further by respecting the priorities of the problem.

In what follows, I explain what happens in the leverage cycle and why it is so bad for the economy that it must be monitored and controlled by the government. I show how this last cycle fits the pattern and I further explain why this leverage cycle is worse than all the others since the Depression. I point out that the now-famous counterparty risk problem, which has received so much attention of late, is also a matter of collateral. Next, I present details on how to intervene to pull out of a leverage cycle crisis like the one we are passing through now; this discussion is divided into three sections, corresponding to the three symptoms of every leverage cycle crisis. I advocate a permanent lending facility that will stand ready, should another crisis arise, to give loans with less collateral than the market demands. In another section, I suggest that principal reduction (partial debt forgiveness) by private lenders is a key tool in dealing with the many agents, like homeowners today, that fall underwater at the bottom of a deep leverage crisis. In the third section, I assemble the many pitfalls the government must be watchful of if it feels obliged to rescue drowning firms or it is tempted to buy assets at “fire-sale” prices in the darkest days of the crisis. I conclude with a list of recommendations for managing the leverage cycle in its ebullient period that might prevent the next cycle from reaching such a devastating crisis stage.

2. MARGINS, THE LEVERAGE CYCLE, AND ASSET PRICES

Traditionally, governments, economists, as well as the general public and the press, have regarded the interest rate as the most important policy variable in the economy. Whenever the economy slows, the press clamors for lower interest rates from the Federal Reserve, and the Fed often obliges. But sometimes, especially in times of crisis, collateral rates (equivalently, margins or leverage) are far more important than interest rates. The Fed could be managing collateral rates all through the leverage cycle, but especially in the ebullient and the crisis stages.

The use of collateral and leverage is widespread. A homeowner (or a big investment bank or hedge fund) can often spend \$20 of his own cash to buy an asset like a house for \$100 by taking out a loan for the remaining \$80 using the house as collateral. In that case, we say that the margin or haircut or down payment is 20 percent, the loan to value is $\$80/\$100 = 80$ percent, and the collateral rate is $\$100/\80 or 125 percent. The leverage is the reciprocal of the margin, namely, the ratio of the asset value to the cash needed to purchase it, or $\$100/\$20 = 5$. All of these *ratios* are different ways of saying the same thing.

In standard economic theory, the equilibrium of supply and demand determines the interest rate on loans. But in real life, when somebody takes out a secured loan, he must negotiate two things: the interest rate and the collateral rate. A proper theory of economic equilibrium must explain both. Standard economic theory has not really come to grips with this problem for the simple reason that it seems intractable: how can one supply-equals-demand equation for a loan determine two variables—the interest rate and the collateral rate? There is not enough space to explain the resolution of this puzzle here, but suffice it to say that ten years ago I showed that supply and demand do indeed determine both. Moreover, the two variables are influenced in the equilibration of supply and demand mainly by two different factors: the interest rate reflects the underlying impatience of borrowers, and the collateral rate reflects the perceived volatility of asset prices and the resulting uncertainty of lenders.³ Another factor influencing leverage in the long run is the degree of financial innovation. Since scarce collateral is often an important limiting factor, the economy will gradually devise ways of stretching the collateral, by tranching (so the same collateral backs several loans) and pyramiding loans (so the same

³ In Geanakoplos (1997), I show how supply and demand can indeed simultaneously determine the interest rate and the collateral rate. In Geanakoplos (2003), I show how intertemporal changes in volatility lead to changes in the equilibrium leverage over time as part of what I call a leverage cycle. In Geanakoplos (1997) and Geanakoplos and Zame (2009), I emphasize the scarcity of collateral and the role of tranching and pyramiding.

collateral can be used over and over to back loans backed by loans).

Practitioners, if not economists, have long recognized the importance of collateral and leverage. For a Wall Street trader, leverage is important for two reasons. The first is that if he is leveraged λ times, then a 1 percent change in the value of the collateral means a λ percent change in the value of his capital. (If the house in our example goes from \$100 to \$101, then after selling the house at \$101 and repaying the \$80 loan, the investor is left with \$21 of cash on his \$20 investment, a 5 percent return.) Leverage thus makes returns riskier, either for better or for worse. Second, a borrower knows that if there is no-recourse collateral, so that he can walk away from his loan after giving up the collateral without further penalty, then his downside is limited. The most the borrower can lose on the house loan is his \$20 of cash, even if the house falls in value all the way to \$0 and the lender loses \$80. No-recourse collateral thus effectively gives the borrower a put option (to “sell” the house for the loan amount). Recently, several commentators have linked leverage to the crisis, arguing that if banks were not so leveraged in their borrowing they would not have lost so much money when prices went down, and that if homeowners were not so leveraged, they would not be so far underwater now and so tempted to exercise their put option by walking away from their house. Of course, these two points are central to my own leverage cycle theory; I discuss them in more detail later. But there is another, deeper point to my theory that has so far not received as much attention, which I think is the real story of leverage.

The main implication of my leverage cycle theory is that when leverage goes up, asset prices go up, and when leverage goes down, asset prices go down.⁴ For many assets, there is a class of natural buyers or optimists who are willing to pay much more for the asset than the rest of the public. They may be more risk-tolerant. Or they may simply be more optimistic. Or they may like the collateral (for example, housing) more.⁵ If they can get their hands on more money through borrowing, they will spend it on the assets and drive those asset prices up. If they lose wealth, or lose the ability to borrow, they will be able to buy less of the asset, and the asset will fall into more pessimistic hands and be valued less.

It is useful to think of the potential investors arrayed on a vertical continuum, in descending order according to their willingness to buy, with the most enthusiastic buyers at the top (see exhibit). Whatever the price, those at the top of the continuum above a threshold will value the asset more and become buyers, while those below will value it less and sell. The

⁴ Leverage is like more money in making prices go up, but, unlike money, it affects only prices of goods that can serve as collateral; printing more money tends to increase all prices, including those of food and other perishables.

⁵ Two additional sources of heterogeneity are that some investors are more expert at hedging assets, and that some investors can more easily obtain the information (like loan-level data) and expertise needed to evaluate the assets.

Natural Buyers Theory of Price



marginal buyer is the agent at the threshold on the cusp of selling or buying and it is his opinion that determines the price. The higher the leverage, the smaller the number of buyers at the top required to purchase all the available assets. As a result, the marginal buyer will be higher in the continuum and therefore the price will be higher.

It is well known that a reduction in interest rates will increase the prices of assets such as houses. It is less appreciated, but more obviously true, that a reduction in margins will raise asset prices. Conversely, if margins go up, asset prices will fall. A potential homeowner who in 2006 could buy a house by putting 3 percent cash down might find it unaffordable to buy now that he has to put 30 percent cash down, even if the Fed managed to reduce mortgage interest rates by 1 percent or 2 percent. This has diminished the demand for housing, and therefore housing prices. What applies to housing applies much more to the esoteric assets traded on Wall Street (such as mortgage-backed investments), where the margins (that is, leverage) can vary much more radically. In 2006, the \$2.5 trillion of so-called toxic mortgage securities could be bought by putting \$150 billion down and borrowing the other \$2.35 trillion.⁶ In early 2009, those same securities might collectively have been worth half as much, yet a buyer might have had to put nearly the whole amount down in cash. In Section 3.1, I illustrate the connection between leverage and asset prices over the current cycle.

Economists and the Federal Reserve ask themselves every day whether the economy is picking the right interest rates. But one can also ask the question whether the economy is picking the right equilibrium margins. At both ends of the leverage cycle, it does not. In ebullient times, the equilibrium collateral rate is too loose; that is, equilibrium leverage is too high. In bad times, equilibrium leverage is too low. As a result, in ebullient times asset prices are too high, and in crisis times they plummet too low. This is the leverage cycle.

⁶ This number is calculated by applying the bank regulatory capital requirement (based on bond credit rating) to each security in 2006 at its 2006 credit rating.

The policy implication of the leverage cycle is that the Fed could manage systemwide leverage, seeking to maintain it within reasonable limits in normal times, stepping in to curtail it in times of ebullience, and propping it up as market actors become anxious, and especially in a crisis. To carry out this task, of course, the Fed must first monitor leverage. The Fed must collect data from a broad spectrum of investors, including hitherto secretive hedge funds, on how much leverage is being used to buy various classes of assets. Moreover, the amount of leverage being employed must be transparent. The accounting and legal rules that govern devices, such as structured investment vehicles, that were used to mask leverage levels must be reformed to ensure that leverage levels can be more readily and reliably discerned by the market and regulators alike. As we shall see, the best way to monitor leverage is to do it at the *security* level by keeping track of haircuts on all the different kinds of assets used as collateral, including in the repo market and in the housing market. Also very useful, but less important, is monitoring the *investor* leverage (or the debt-equity ratio) of big firms.

The leverage cycle is no accident, but a self-reinforcing dynamic. Declining margins, or, equivalently, increasing leverage, are a consequence of the happy coincidence of universal good news and the absence of danger on the horizon. With markets stable and the horizon looking clear, lenders are happy to reduce margins and provide more cash. Good, safe news events by themselves tend to make asset prices rise. But they also encourage declining margins, which in turn cause the massive borrowing that inflates asset prices still more.

Similarly, when the news is bad, asset prices tend to fall on the news alone. But the prices often fall further if the margins are tightened. Sudden and dramatic increases in margins are relatively rare. They seem to happen once or twice a decade. Bad news arrives much more often than that, so it is not bad or even very bad news alone that drastically raises margins. Bad news lowers expectations, and, like all news, usually clarifies the situation.

Every now and then, bad news, instead of clarifying matters, increases uncertainty and disagreement about the future. It is this particular kind of “scary bad” news that increases margins. For example, when an airline announces the plane will be ten minutes late, the passengers start to worry the delay might be an hour. When a bank announces a \$5 billion loss, investors worry that more losses might be on the way. In 2006, people disagreed about whether losses from defaults on prime mortgages would be 1/4 percent or 1/2 percent, and whether losses on subprime mortgages would be 1 percent or 5 percent. By contrast, after the scary news of 2007, people disagreed about whether some subprime losses would be 30 percent or 80 percent. Even from their low, many lenders were afraid many assets could lose even more value, maybe all their value. The present became worse, and the future more uncertain.

The upshot of increased uncertainty and disagreement is that margins go up drastically. Lenders are typically more pessimistic than buyers. Otherwise, they too would be buying, instead of lending. Even if the optimists are not worried much about more losses, the lenders are, and they will demand high margins. When the lenders are worried about 80 percent losses from current levels, they will lend only if margins are at least 90 percent, or not lend at all.

As we have just witnessed, the rapid increase in margins always comes at the worst possible time. Buyers who were allowed to massively leverage their purchases with borrowed money are forced to sell when bad news drives asset prices lower. But when margins rise dramatically, more modestly leveraged buyers are also forced to sell. Tightening margins turn willing buyers into forced sellers, driving prices further down. We enter the crisis stage I discuss below.

The dynamic of the leverage cycle cannot be stopped by a tongue lashing of greedy Wall Street investors or overly ambitious homeowners in the ebullient stage of the cycle, nor by exhortations not to panic in the crisis stage. The cycle emerges even if (in fact, precisely because) every agent is acting rationally from his individual point of view. It is analogous to a prisoner’s dilemma, where individual rationality leads to collective disaster. The government must intervene.

The intervention becomes all the more necessary if agents are irrationally exuberant and then irrationally panicked, or are prone to short-sighted greed, or to the “keeping up with the Jones” syndrome. If greedy investors want higher expected returns, no matter what the risk, competition will force even conservative fund managers to leverage more. For example, an investor comes to a hedge fund and says, “the fund down the block is getting higher returns.” The fund manager counters that the competitor is just using more leverage. The investor responds, “well whatever he’s doing, he’s getting higher returns.” Pretty soon, both funds are leveraging more. Housing prices can rise in the same way. When some families borrow a lot of money to buy their houses, housing prices rise and even conservative homeowners are forced to borrow and leverage so they too can live in comparable houses, if keeping up with their peers is important to them. At the bottom end, nervous investors might withdraw their money, forcing hedge fund managers to sell just when they think the opportunities are greatest. However, of all the irrationalities that exacerbated this leverage cycle, I would not point to these or to homeowners who took out loans they could not really afford, but rather to lenders who underestimated the put option and failed to ask for enough collateral.

The observation that collateral rates are even more important outcomes of supply and demand than interest rates, and even more in need of regulation, was made over 400 years

ago. In *The Merchant of Venice*, Shakespeare depicted accurately how lending works: one has to negotiate not just an interest rate but the collateral level too. And it is clear which of the two Shakespeare thought was the more important. Who can remember the interest rate Shylock charged Antonio? But everybody remembers the “pound of flesh” that Shylock and Antonio agreed on as collateral. The upshot of the play, moreover, is that the regulatory authority (the court) intervenes and decrees a new collateral level—very different from what Shylock and Antonio had freely contracted—“a pound of flesh, but not a drop of blood.” The Fed, too, could sometimes decree different collateral levels (before the fact, not after, as in Shakespeare).

The modern study of collateral seems to have begun with Kiyotaki and Moore (1997), Bernanke, Gertler, and Gilchrist (1996, 1999), Holmstrom and Tirole (1997), Geanakoplos (1997, 2003), and Geanakoplos and Zame (2009).⁷ Bernanke, Gertler, and Gilchrist and Holmstrom and Tirole emphasize the asymmetric information between borrowers and lenders as the source of limits on borrowing. For example, Holmstrom and Tirole argue that the managers of a firm would not be able to borrow all the inputs necessary to build a project, because lenders would like to see them bear risk, by putting their own money down, to guarantee that they exert maximal effort. Kiyotaki and Moore (1997) and Geanakoplos (1997) study the case where the collateral is an asset such as a mortgage security, where the buyer/borrower using the asset as collateral has no role in managing the asset, and asymmetric information is therefore not important. The key difference between Kiyotaki and Moore and Geanakoplos (1997) is that in Kiyotaki and Moore, there is no uncertainty, and so the issue of leverage as a ratio of loan to value does not play a central role; to the extent it does vary, leverage in Kiyotaki and Moore goes in the wrong direction, getting higher after bad news, and dampening the cycle. In Geanakoplos (1997, 2003), I introduce uncertainty and solve for equilibrium leverage and equilibrium default rates; I show how leverage could be determined by supply and demand, and how under some conditions, volatility (or more precisely, the tail of the asset return distribution) pins down leverage. In Geanakoplos (2003), I introduce the leverage cycle in which changes in the volatility of news lead to changes in leverage, which in turn lead to changes in asset prices. This line of research has been pursued by Gromb and Vayanos (2002), Fostel and Geanakoplos (2008), Brunnermeier and Pedersen (2009), and Adrian and Shin (forthcoming), among others.

⁷ Minsky (1986) was a modern pioneer in calling attention to the dangers of leverage. But to the best of my knowledge, he did not provide a model or formal theory. Tobin and Golub (1998) devote a few pages to leverage and the beginnings of a model.

2.1 Investor Heterogeneity, Equilibrium Leverage, Default, and Maturity

Without heterogeneity among investors, there would be no borrowers and lenders, and asset prices would not depend on the amount of leverage in the economy. It is interesting to observe that the kind of heterogeneity influences the amount of equilibrium leverage, and hence equilibrium asset prices, and equilibrium default.

When investors differ only in their optimism about future events in a one-dimensional manner, then the equilibrium leverage will consist of the maximum promise that does not permit default.⁸ For example, suppose an asset will be worth either 1 or .2 next period. Suppose further that risk-neutral investors differ only in the probability h that they assign to the outcome being 1. The most optimistic investor $h = 1$ is sure that the asset will be worth 1, and the most pessimistic investor $h = 0$ is sure the asset will be worth .2. At any asset price p , the investors with h big enough that $h*1 + (1-h)*(.2) > p$ will want to buy the asset, while the rest will want to sell the asset. The buyers with high h will want to borrow money in order to get their hands on what they regard as cheap assets, while the sellers with low h will not need the money and so will be willing to lend. How much will the borrowers be able to promise using the asset as collateral, assuming the promise is not contingent on the state? The answer is .2, precisely the maximum promise that does not lead to default in either state.⁹

Thus, when the heterogeneity stems entirely from one-dimensional differences in opinion, equilibrium leverage entails no default. A consequence of this is that the loans will be very short term. The longer the maturity of the loan, the more that can go wrong in the meantime, and therefore the smaller the loan amount can be if it avoids any chance of default. Investors who want to borrow large amounts of money will be driven to borrow very short term. The repo market displays these characteristics of short, one-day loans, on which there is almost never any default, even in the worst of crises.

Much the same analysis holds when investors differ only in their risk aversion. For the most risk-averse investors, an asset that pays 1 or .2 will be regarded as too dangerous, while

⁸ See Geanakoplos (2003).

⁹ At first glance, it would seem that the most optimistic buyers might be willing to promise, say, .3 in both states, in order to get more money today to invest in a sure winner of an asset. But since this promise will deliver .3 in the good state but only .2 in the bad state (assuming no-recourse collateral), the lenders will not want to pay much for this debt: this risky debt is very much like the asset they do not want to hold, and so they will pay very little more for it than the (.2,.2) promise, where (g,b) denotes a payoff of g if the good state occurs and b if the bad state occurs. Since the borrowers would have to give up .3 > .2 in the state they think is likely to occur, they will choose to use their scarce collateral to back the (.2,.2) promise instead of the (.3,.3) promise.

investors with greater risk tolerance will find it attractive at the right price. These risk-tolerant investors will leverage their purchases, by borrowing money to buy the asset, using it as collateral for their loan. Once again, the equilibrium leverage will rise to the point that the promises made will be $(.2, .2)$ but no more (see footnote 9 for an explanation of notation). To be more concrete, suppose contrary to the previous case, that all the agents regard the outcomes 1 and .2 as equally likely. But suppose that untraded endowments rise and fall together with the asset payoffs. Then risk-averse agents on the margin will regard an extra penny when the asset pays 1 as less valuable than an extra penny when the asset pays .2; on the margin, they would prefer a penny when the asset pays .2. Hence, they will behave as if they regarded the payoff of 1 as less likely, exactly the same way the pessimists behaved, despite having the same beliefs as the risk-tolerant agents. Equilibrium leverage with heterogeneous risk aversion becomes the same as with heterogeneous beliefs.

The situation changes when some investors simply like owning the asset for its own sake in the period they buy it, such as when a homeowner likes living in the house. A similar situation arises if a producer can get more output from the asset than can be recovered if the lender takes it over. Somewhat surprisingly, in these cases the equilibrium leverage might be to promise $(1, 1)$ even when the asset will only deliver $(1, .2)$ with probabilities everyone agrees on. If there are multiple states, and a cost of seizing the collateral, then the equilibrium promise will be somewhere between the maximum and minimum delivery. Contrary to the previous two cases, equilibrium leverage will involve a distinctly positive probability of default. Furthermore, in order to avoid the default costs of seizing the collateral, the equilibrium loans will be longer term, as in the mortgage market, where we see defaults and long-maturity loans.

2.2 The Crisis Stage

The crisis stage of the leverage cycle always seems to unfold in the same way. First there is bad news. That news causes asset prices to fall based on worse fundamentals. Those price declines create losses for the most optimistic buyers, precisely because they are typically the most leveraged. They are forced to sell off assets to meet their margin restrictions, even when the margins stay the same. Those forced sales cause asset prices to fall further, which makes leveraged buyers lose more. Some of them go bankrupt. And then typically things shift: the loss spiral seems to stabilize—a moment of calm in the hurricane's eye. But that calm typically gives way when the bad news is the

scary kind that does not clarify but obscures the situation and produces widespread uncertainty and disagreement about what will happen next. Suddenly, lenders increase the margins and thus deliver the fatal blow. At that point, even modestly leveraged buyers are forced to sell. Prices plummet. The assets eventually make their way into hands that will take them only at rock-bottom prices.

During a crisis, margins can increase 50 percent overnight, and 100 percent or more over a few days or months. New homeowners might be unable to buy, and old homeowners might similarly be unable to refinance even if the interest rates are lowered. But, holding long-term mortgages, at least they do not have to put up more cash. For Wall Street firms, the situation is more dire. They often borrow for one day at a time in the repo market. If the margins double the next day, then they immediately have to double the amount of cash they hold for the same assets. If they do not have all that cash on hand, they will have to sell the assets. This is called deleveraging.

All this would happen even if traders were completely rational, processing information dispassionately. When we add the possibility of panic and the turmoil created by more and more bankruptcies, it is not surprising to see lending completely dry up.

2.3 The Aftermath of the Crisis

After the crisis ends, many businesses and individuals will be broke and unemployed. Parts of the economy will be disrupted, and some markets may be on the verge of shutting down. The government will then face the choice of who to assist, and at what cost. This assistance will typically be very inefficient, causing further losses to economic productivity. Doubts about which firms will survive will create more uncertainty, contributing to a difficult lending environment.

2.4 What Is So Bad about the Leverage Cycle?

The crisis stage is obviously bad for the economy. But the leverage that brings it on stimulates the economy in good times. Why should we think the bad outweighs the good? After all, we are taught in conventional complete-markets economics that the market decides best on these types of trade-offs. In Geanakoplos (2010), I discuss eight reasons why the leverage cycle may nevertheless be bad for the economy. The first three are caused by the large debts and numerous bankruptcies that occur in big leverage cycles.

First, optimistic investors can impose an externality on the economy if they internalize only their private loss from a bankruptcy in calculating how much leverage to take on. For example, managers of a firm calculate their own loss in profits in the down states, but sometimes neglect to take into their calculations the disruption to the lives of their workers when they are laid off in bankruptcy. If, in addition, the bankruptcy of one optimist makes it more likely in the short run that other optimists (who are also ignoring externalities) will go bankrupt, perhaps starting a chain of defaults, then the externality can become so big that simply curtailing leverage can make everybody better off.

Second, debt overhang destroys productivity, even before bankruptcy, and even in cases when bankruptcy is ultimately avoided. Banks and homeowners and others who are underwater often forgo socially efficient and profitable activities. A homeowner who is underwater loses much of the incentive to repair a house, even if the cost of the repairs is less than the gain in value to the house, since increases in the value of the house will not help him if he thinks he will likely be foreclosed eventually anyway.¹⁰

Third, seizing collateral often destroys a significant part of its value in the process. The average foreclosure of a subprime loan leads to recovery of only 25 percent of the loan, after all expenses and the destruction of the house are taken into account, as I discuss later. Auction sales of foreclosed houses usually bring 30 percent less than comparable houses sold by their owners.

The next four reasons stem from the swings in asset prices that characterize leverage cycles. A key externality that borrowers and lenders in both the mortgage and repo markets do not recognize is that if leverage were curtailed at the high end of the leverage cycle, prices would fall much less in the crisis. Foreclosure losses would then be less, as would inefficiencies caused by agents being so far underwater. One might argue that foreclosure losses and underwater inefficiencies should be taken into account by a rational borrower and lender and be internalized: it may be so important to get the borrower the money, and the crisis might ex ante be so unlikely, that it is “second best” to go ahead with the big leverage and bear the cost of the unlikely foreclosure. But that overlooks the pecuniary externality: by going into foreclosure, a borrower lowers housing prices and makes it more likely that his neighbor will do the same.

Fifth, asset prices can have a profound effect on economic activity. As James Tobin argues with his concept of Q, when the prices of old assets are high, new productive activity, which often involves issuing financial assets that are close substitutes for the old assets, is stimulated. When asset prices are low, new activity might grind to a halt.¹¹ When asset prices are well above the

¹⁰ See Myers (1977) and Gyourko and Saiz (2004).

complete-markets price, because of the expectation by the leveraged few that good times are coming, a huge wave of overbuilding usually results. In the bad state, this overbuilding needs to be dismantled at great cost and, more importantly, new building nearly stops. To make the point a bit more dramatically, very high leverage means that the asset prices are set by a small group of investors. If agent beliefs are heterogeneous, why should the prices be determined entirely by the highest outliers? In the current crisis, as I observed earlier, the \$2.5 trillion of toxic mortgage securities were purchased with about \$150 billion in cash and \$2.35 trillion in loans. As of 2006, just two men, Warren Buffet and Bill Gates, between them had almost enough money to purchase every single toxic mortgage security in the whole country. Leverage allows the few to wield great influence on prices and therefore on what is produced.¹²

Sixth, a large group of small businesspeople who cannot buy insurance against downturns in the leverage cycle can easily sell loans to run their businesses or pay for their consumption in good times at the height of the leverage cycle, but have a hard time at the bottom. Government policy may well have the goal of protecting these people by smoothing out the leverage cycle.¹³

Seventh, the large fluctuations in asset prices over the leverage cycle lead to massive redistributions of wealth and changes in inequality. When leverage $\lambda = 30$, there can be wild swings in returns and losses. In the ebullient stage, the optimists become rich as their bets pay off, while in the down states, they might go broke. Inequality becomes extreme in both kinds of states.¹⁴

The eighth problem with the leverage cycle is caused by the inevitable government responses to the crisis stage. In an effort to mitigate the crisis, the government often intervenes in inefficient ways. In the current crisis, the government is supporting the financial sector by holding the federal funds rate near zero. The government’s foreclosure prevention efforts have created financial subsidies for households that opt not to move, which can create inefficiencies in labor market adjustment.¹⁵ Government bailouts, even if they were all for the public good, cause resentment from those who are not bailed out. The agents in the economy do not take into account that by leveraging more and putting the economy at greater

¹¹ See Tobin and Golub (1998).

¹² Standard economics does not really pay any attention to the case where agents have different beliefs, and median beliefs are closer to the truth than extreme outliers.

¹³ Here I rely on Tobin’s Q and the absence of insurance markets. The small businessmen cannot insure themselves against the crisis stage of the leverage cycle. In conventional complete-markets economics, they would be able to buy insurance for any such event. Geanakoplos and Polemarchakis (1986) offer a proof that when insurance markets are missing, there is almost always a government intervention in the existing markets that will make everyone better off.

¹⁴ This is a purely paternalistic reason for curtailing leverage.

¹⁵ See Ferreira et al. (forthcoming).

risk, they create more inefficient government interventions. And of course, the expectation of being assisted by the government, should things go wrong, causes many agents to be more reckless in the first place.¹⁶

3. THE LEVERAGE CYCLE OF 2000-09 FITS THE PATTERN

3.1 Leverage and Prices

By now, it is obvious to everybody that asset prices soared from 1999 (or at least after the disaster period that began September 11, 2001) to 2006, and then collapsed from 2007 to 2009. My thesis is that this rise in prices was accompanied by drastic changes in leverage, and was therefore just part of the 1999-2006 upswing in the leverage cycle after the crisis stage in 1997-98 at the end of the last leverage cycle. I do not dispute that irrational exuberance and then panic played a role in the evolution of prices over this period, but I suggest that they may not be as important as leverage; certainly, it is harder to regulate animal spirits than it is leverage.

Let us begin with the housing bubble, famously documented by Robert Shiller. In Chart 1, I display the Case-Shiller national housing index for 2000-09. It begins at 100 in 2000:1, reaches 190 in 2006:2, and falls to 130 by 2009:1, as measured on the right vertical axis. But I superimpose on that graph a graph of leverage available to homeowners each month. This is measured on the left vertical axis and labeled “Down payment for mortgage,” which is 100 percent minus the loan-to-value (LTV) ratio. To compute this, I begin by looking house by house each month from 2000-09 at the ratio of all the outstanding mortgage loans (usually a first and sometimes a second lien) to the appraised value of the house at the moment a first mortgage was issued for every subprime and alt-A house available in the First American CoreLogic LoanPerformance Data Base. I then average over the 50 percent houses with the highest LTV levels.¹⁷ In this way, I obtain a robust estimate of leverage offered to homeowners. By leaving out the bottom 50 percent, I ignore homeowners who clearly chose to leverage less than they could have, and by including all homes in the top 50 percent, I ensure that the leverage measure was really available and not just a special deal for a few outliers. If anything, my numbers underestimate the offered leverage.¹⁸

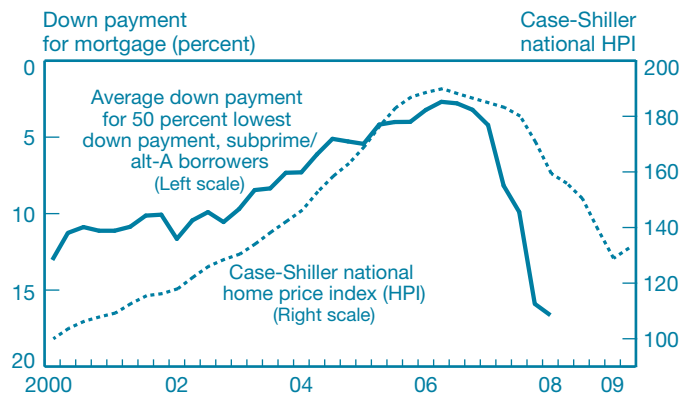
¹⁶ This mechanism has been formalized in Farhi and Tirole (2009).

¹⁷ These data were compiled and analyzed by the research team at the hedge fund Ellington Capital Management.

CHART 1

Housing Leverage Cycle

Margins Offered (Down Payments Required) and Home Prices



Sources: First American CoreLogic LoanPerformance Data Base; Ellington Capital Management.

Notes: The down payment axis has been reversed, because lower down payment requirements are correlated with higher home prices. For every alt-A or subprime first-lien loan origination from 2000:1 to 2008:1, the down payment percentage was calculated as appraised value (or sale price, if available) minus total mortgage debt, divided by appraised value. For each quarter, the down payment percentages were ranked from highest to lowest, and the average of the bottom half is shown. This number is an indicator of the down payment required; clearly, many homeowners put down more than they had to, which is why the top half is dropped from the average. A 13 percent down payment in 2000:1 corresponds to leverage of about 7.7, and a 2.7 percent down payment in 2006:2 corresponds to leverage of about 37. Subprime/alt-A issuance ended in 2008:1.

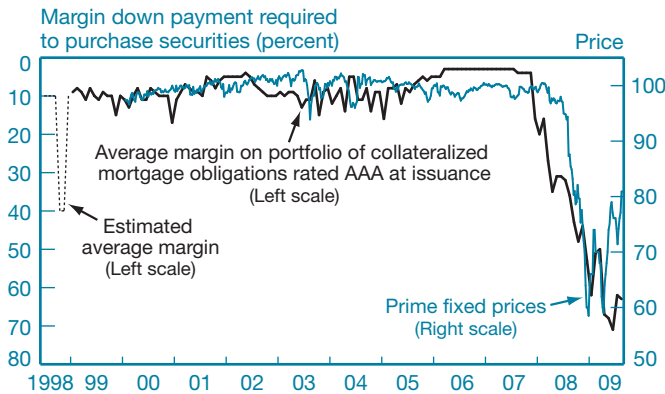
It is striking how correlated prices and leverage are, rising and then falling together. Especially noteworthy is that leverage peaks in 2006:2, with 2.7 percent down, exactly when housing prices peak, and heads down much faster than housing prices.

In Chart 2, I present the history of the J.P. Morgan AAA prime floater mortgage index from about 2000 to 2009. The index is measured on the right vertical axis. The prime mortgages underlying the bonds in the index were taken out by investors with pristine credit ratings, and the bonds are also protected by some equity in their deals. For most of its history, this index stays near 100, but starting in early 2008, it falls rapidly, plummeting to 60 in early 2009. The cumulative losses on these prime loans even today are still in the single digits; it is hard to imagine them ever reaching 40 percent (which would mean something like 80 percent foreclosures with only 50 percent recoveries). It is of course impossible to know what people were thinking about potential future losses when the index fell to 60 in late 2008 and early 2009. My hypothesis is that leverage played a big role in the price collapse.

¹⁸ At the peak of nonprime lending in mid-2005, these loans represented 45 percent of the flow of new mortgage borrowing (correspondence with editors).

CHART 2

Securities Leverage Cycle
Margins Offered and AAA-Rated Securities Prices



Sources: Ellington Capital Management; J.P. Morgan.

Notes: The chart represents the average margin required by dealers on a hypothetical portfolio of bonds subject to certain adjustments described below. The margin axis has been reversed, because lower margins are correlated with higher prices. The portfolio evolved over time, and changes in average margin reflect changes in composition as well as changes in margins of particular securities. In the period following August 2008, a substantial part of the increase in margins is attributable to bonds that could no longer be used as collateral after being downgraded, or for other reasons, and hence count as 100 percent margin.

On the left vertical axis, I give the loan-to-value, or, equivalently, the down payment or margin, *offered* by Wall Street banks to the hedge fund Ellington Capital Management on a changing portfolio of AAA mortgage bonds.¹⁹ As I noted earlier, it is astonishing that the Fed itself does not have such historical data. Fortunately, the hedge fund Ellington, which I have worked with for the past fifteen years, does keep its own data. The data set is partly limited in value by the fact that the data were only kept for bonds Ellington actually followed, and these changed over time. Some of the variation in average margin is due to the changing portfolio of bonds, and not to changes in leverage. But the numbers, while not perfect, provide substantial evidence for my hypothesis and tell a fascinating story. In the 1997-98 emerging markets/mortgage crisis, margins shot up, but quickly returned to their previous levels. Just as housing leverage picked up over the period after 1999, so did security level leverage. Then in 2007, leverage dramatically fell, falling further in 2008, and leading the drop in security prices. Very recently, leverage has started to increase again, and so have prices.

¹⁹ These are the offered margins and do not reflect the leverage chosen by Ellington, which since 1998 has been drastically smaller than what was offered.

CHART 3

VIX Index

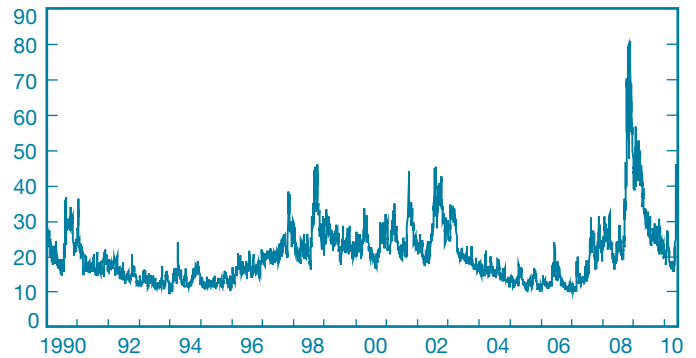


Chart 3 displays the history of implied volatility for the S&P 500, called the VIX index. Volatility in equities is by no means a perfect proxy for volatility in the mortgage market, but it is striking that the VIX reached its peak in 2008 at the crisis stage of the current leverage cycle, and reached a local peak in 1998 at the bottom of the last leverage cycle in fixed-income securities. The VIX also shot up in 2002, but there is no indication of a corresponding drop in leverage in the Ellington mortgage data.

3.2 What Triggered the Crisis?

The subprime mortgage security price index collapsed in January 2007. The stock market kept rising until October 2007, when it too started to fall, losing eventually around 57 percent of its value by March 2009 before rebounding to within 27 percent or so of its October peak in January 2010. What, you might wonder, was the cataclysmic event that set prices and leverage on their downward spiral?

The point of my theory is that the fall in prices from scary bad news is naturally going to be out of proportion to the significance of the news, because the scary bad news precipitates and feeds a plunge in leverage. A change in volatility, or even in the volatility of volatility, is enough to prompt lenders to raise their margin requirements. The data show that that is precisely what happened: margins were raised. But that still begs the question, what was the news that indicated volatility was on the way up?

One obvious answer is that housing prices peaked in mid-2006, and their decline was showing signs of accelerating in the beginning of 2007. But I do not wish to leave the story there. Housing prices are not exogenous; they are central to the leverage cycle. So why did they turn in 2006?

3.3 Why Did Housing Prices Start to Fall?

Many commentators have traced the beginning of the subprime mortgage crisis to falling housing prices. But they have not asked why housing prices started to fall. Instead, they have assumed that housing prices themselves, fueled on the way up by irrational exuberance and on the way down by a belated recognition of reality, were the driving force behind the economic collapse.

I see the causality going in the other direction, starting with the turnaround in the leverage cycle. The leverage cycle was of course greatly exacerbated by the terrible consequences of falling housing prices, which then fed back to cause further housing declines.

As I hope I have made clear, in my view housing prices soared because of the expansion of leverage. Greater leverage enabled traditional buyers to put less money down on a bigger house, and therefore pushed up housing prices. It also enabled people to buy houses who previously did not have enough cash to enter the market, pushing housing prices up even further.

There is, however, a limit on how much leverage can increase, and on how many new people can enter the market. Though negative amortizing loans pushed the envelope, no money down is a natural threshold beyond which it is hard to move. And as more and more households entered the market with less and less money down, lenders began to become apprehensive that these people were less reliable and more inclined to exercise their put option to walk away from the house if housing prices fell. The rapidly expanding supply of new housing demand, fueled by access to easy mortgages, began to slow for completely rational reasons, not because of a sudden pricking of irrational exuberance. This naturally led to a peak in housing prices by 2006:2. But this does not explain why housing prices should steeply decline. Indeed, over the next two quarters, prices and leverage waffled, both moving slightly in a negative direction: During the last half of 2006, housing down payment requirements rose slightly, from 2.7 percent to 3.2 percent, and prices fell slightly, by 1.8 percent.

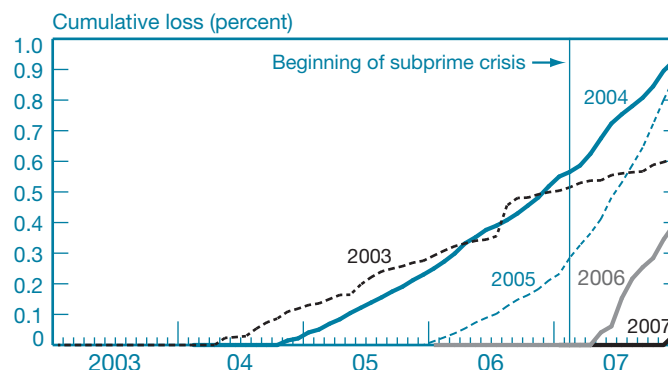
At that point, bad news appeared in the securities market in the form of rising delinquencies. Charts 4 and 5 show losses and delinquencies of Countrywide deals by vintage.²⁰ (These deals are fairly representative of the whole subprime market.)

One can see in Chart 4 that by January 2007, losses for the 2005 vintage were just 0.2 percent and losses for the 2006 vintage were nonexistent. But the 2005 and 2006 delinquencies displayed in Chart 5 were already approaching 5 percent, more than double those of previous vintages. More disturbing, they showed no signs of leveling off. This is precisely the kind of scary news that creates wide uncertainty about what might

²⁰ Data were provided by Ellington Capital Management.

CHART 4

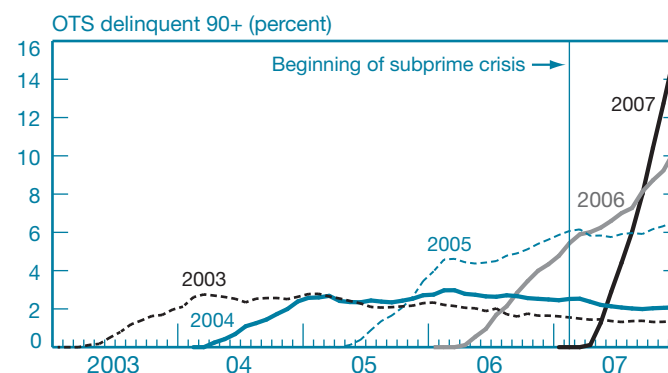
Cumulative Loss of Original Balance



Source: Ellington Capital Management.

CHART 5

Delinquencies on Original Balance

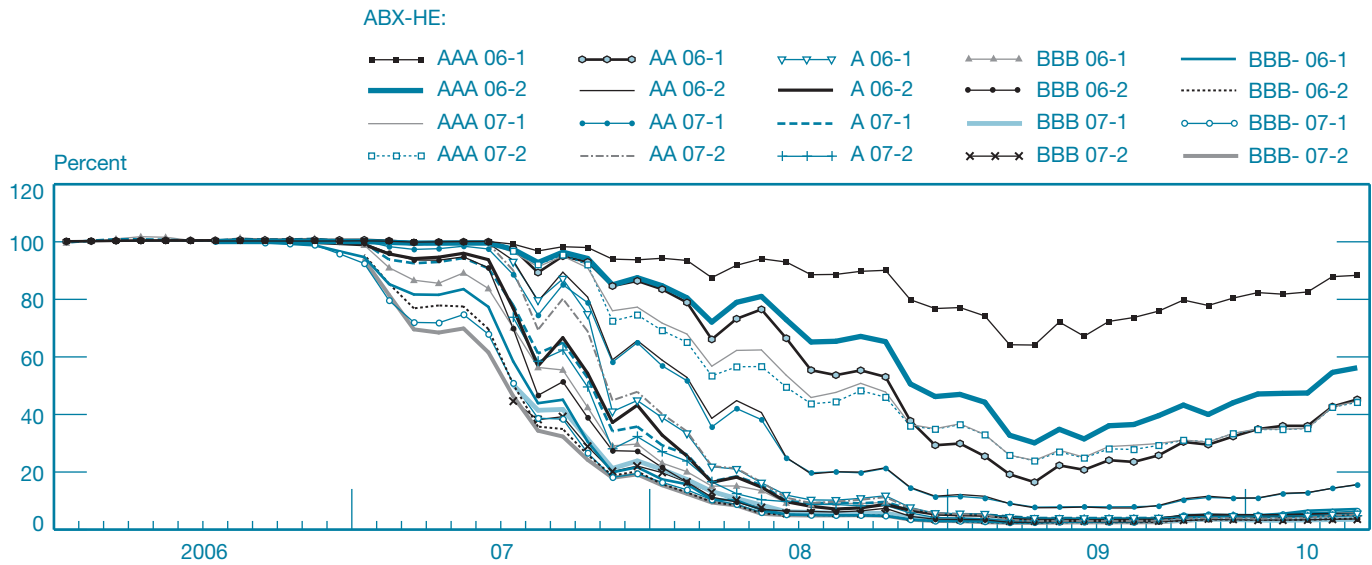


Source: Ellington Capital Management.

happen next. With that new information, how much extrapolation should a buyer from 2006 have made in his expectations of losses and delinquencies going forward?

The ABX index for 2006 vintage subprime bonds began to fall in November 2006 with the smallest trickle of bad news about homeowner delinquencies, then spiked downward in January 2007 after the year-end delinquency report (Chart 6). This price drop of 2006 BBB bonds to below 80 implied that the market was suddenly anticipating huge losses on subprime deals on the order of 10 percent. Recall that for a pool of mortgages to lose 9 percent or 10 percent of its value, the market must anticipate that something like 30 percent of the homeowners will be thrown out of their houses, with 30 percent losses on the mortgage on each home sold (30 percent x 30 percent = 10 percent). This expectation turned out to be not pessimistic enough, but at that time it was a heroic extrapolation from the observed delinquencies of less than 5 percent.²¹

CHART 6
ABX Index



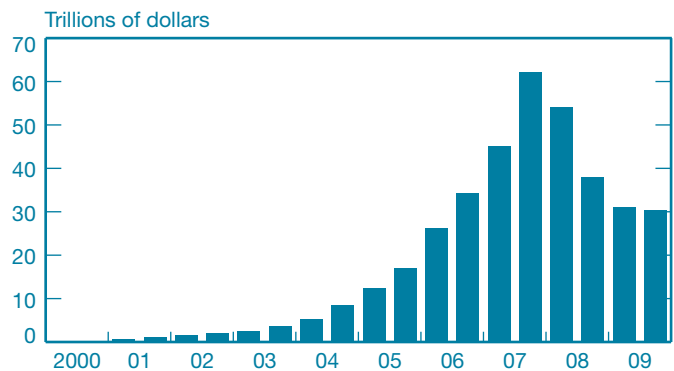
My contention is that this sudden drop in prices, and the further price declines later, were not simply the result of a drop in expected payoffs (that is, in fundamentals) by the same old buyers, but also the result of a change in the marginal buyer. A critical new downward force entered the market for mortgage securities. Standardized credit default swaps (CDS) on mortgage bonds were created for the first time in late 2005, at the very height of the market. The volume of CDS expanded rapidly throughout 2006 and especially in 2007 (Chart 7).²² A CDS is an insurance contract for a bond. By buying the insurance, the pessimists for the first time could leverage their negative views about bond prices and the houses that backed them. Instead of sitting out of the subprime securities market, pessimists could actively push bond prices down. Their purchase of insurance is tantamount to the creation of more (“synthetic”) bonds; naturally, the increase in supply pushed the marginal buyer down and thus the price down.

In January 2007, after the dramatic fall in BBB subprime mortgage prices, housing prices were still only 1.8 percent off their peak. Though the peak of the housing market preceded

the peak of the securities market, the collapse in securities prices preceded the significant fall in housing prices. Thus, in my view the trigger for the downturn in bonds was the bad news about delinquencies and the concurrent creation of the standardized CDS market in subprime mortgage indexes, which then spilled over into the housing market.

The downward pressure on bond prices from credit default swaps and worrisome delinquency numbers meant that new securitizations became more difficult to underwrite. Securitizers of new loans looked for better loans to package in order to continue to back bonds worth more than the loan amounts they had to give homeowners. They asked for loans with more collateral. As Chart 7 shows, from 2006:4 to 2007:4,

CHART 7
Volume of Credit Default Swaps



Source: “ISDA Market Survey: Historical Data.”

²¹ The collapse of the ABX index in January 2007 is a powerful illustration of the potency of market prices to convey information. This first market crash should have been enough to alert our government to the looming foreclosure disaster, but three years later we still have not taken decisive action to mitigate foreclosures.

²² Chart 7 is derived from data provided in “ISDA Market Survey: Historical Data,” available at www.isda.org/statistics/historical/html. Unfortunately, it includes all CDS, not just CDS on mortgages. The data on mortgage CDS seem difficult to find, since these CDS were traded bilaterally and not on an exchange. It seems very likely to me that the mortgage CDS increased even more dramatically from 2004-05 to 2006-07.

the required down payment on houses rose dramatically from 3.2 percent to 15.9 percent (equivalently, LTV fell from 96.8 percent to 84.1 percent). This meant that potential new homeowners began to be closed out of the market, which of course reduced home prices. In that same period, housing prices began to fall rapidly, declining by 8.5 percent.

But more insidiously, the desire by lenders to have more collateral for each dollar loaned kept homeowners from refinancing because they simply did not have the cash: given the drop in the permissible LTV ratio, and the fall in housing prices, they suddenly needed to put down 25 percent of their original loan in cash to refinance. Refinancing virtually stopped overnight. Until 2007, subprime bondholders could count on 70 percent or so of subprime borrowers refinancing by the end of their third year.²³ These homeowners began in pools that paid a very high rate of interest because of their low credit rating. But after two years of reliable mortgage payments, they would become eligible for new loans at better rates, which they traditionally took in vast numbers. Of course, a prepayment means a full payment to the bondholder. Once refinancing plummeted and this sure source of cash disappeared, the bonds became much more at risk and their prices fell more. Margins on bonds began to tighten.

Mortgagees who had anticipated being able to refinance were trapped in their original loans at high rates; many subsequently became delinquent and entered foreclosure. Foreclosures obviously lead to forced sales and downward pressure on housing prices. And falling home prices are a powerful force for further price reductions, because when house values fall below the loan amount, homeowners lose the incentive to repay their loans, leading to more defaults, foreclosures, and forced selling. All this leads back to falling security prices and tighter margins on securities.

The feedback from falling security prices to higher margins on housing loans to lower house prices and then back to tougher margins on securities and to lower security prices and then back again to housing is what I call “the double leverage cycle.”

4. WHY THIS LEVERAGE CYCLE IS THE WORST SINCE THE GREAT DEPRESSION

Every leverage cycle has the same broad features. The crisis stage of every leverage cycle is bad. But the current crisis is far worse than the crises we saw in the two previous leverage cycles. There are a number of reasons why this cycle is worse than all previous cycles since the Depression, but the unifying theme

²³ Seventy-four percent of all subprime loans issued in or before 2004 had refinanced by the end of their third year, according to the First American CoreLogic LoanPerformance Data Base.

behind all of them is a failure to put up enough collateral to back promises.

4.1 Securities Leverage Got Higher then Fell Farther than Ever Before

In this cycle, leverage on traditional collateralizable assets increased to more than the highs from the previous cycle. That can be seen in the history of one mortgage hedge fund’s margins (haircuts) over the last eleven years (Chart 2). Note in the chart that before the crisis of 1997-98 that ended the last leverage cycle, leverage was about 10 to 1 (margins were about 10 percent). During the 1998 crisis, margins jumped to 40 percent, staying there about two months, before returning to their previous levels of 10 percent. In the “great moderation” in the nine years afterward, when volatility got very low, leverage increased from about 10 to 1 to about 20 to 1 (the margins fell from 10 percent to 5 percent).

Beginning in 2007 (after reaching its peak in 2006), leverage collapsed, with margins going from 5 percent to 70 percent on average. Two years after the collapse, leverage was still low, whereas in 1998 the crisis was all over in two months.

The most dramatic change in margins has come from assets that were rated AAA, and that have been, or are about to be, downgraded. Previously, one could borrow 90 or even 98.4 cents on a dollar’s worth of AAA assets, and now one cannot borrow anything at all with these assets as collateral. According to Moody’s, AAAs are supposed to have a 1 in 100 risk of default over a ten-year period.²⁴ We are now seeing over 50 percent of all alt-A and subprime AAA bonds partially defaulting, and we will see virtually 100 percent of all AAA collateralized debt obligations (CDOs) partially default. Even when some assets have little or no chance of losing more than a few percent of their value, the market no longer trusts the AAA rating, and lenders will not lend anything on them.

In the run-up to the present crisis, financial innovation enabled many new kinds of assets to become usable as collateral. Thus, even if margins had not declined on old collateral, the leverage of the economy as a whole would have increased because there was new borrowing backed by previously unusable collateral, which brings us to pooling and securitization.

The process of pooling and securitization has been a crucial source of new collateral and increased leverage. Imagine a single subprime mortgage loan. Even in the days when it was believed that the expected loss from such a mortgage was between 1 percent and 4 percent, people still recognized that

²⁴ See Backman and O’Connor (1995).

there was a nontrivial chance of a much bigger loss on a single loan. Lenders, inherent pessimists, would not have considered lending using a single subprime mortgage as collateral. But now consider a pool of subprime mortgages from around the country. If one believed that the loans were independent, so that a housing price decline in Detroit did not imply a housing price decline in California, then on a big enough pool of loans, the chance for more than 30 percent default might be considered less than 1 in 10,000. Even a very pessimistic lender who believed in a 4 percent expected loss per loan would be willing to lend 70 percent of the value of the entire pool, provided that he got paid before anyone else. Thus, a buyer of the pool of mortgages could imagine borrowing 70 percent of their collective value, when it would have been impossible to borrow anything on the individual loans.

Securitization took this borrowing on pools one step further by converting the loans into long-term loans. The underwriter of the pool typically issued different bonds, whose payments depended on the homeowners' payments on their loans. Consider, for example, a bond structure with just two "tranches" of bonds. The senior tranche might pay interest slightly above the riskless government rate on the best 70 percent of the loans. As long as losses on the pool are below 30 percent, the senior tranche holder continues to get paid his interest and eventually his principal. The junior bondholder receives what is left from the pool after the senior bondholder is paid. The whole securitized structure can be interpreted as if the buyer of the junior piece actually bought the whole pool, using a long-term loan from the buyer of the senior piece, collateralized by the whole pool. Once one understands the juniors as effectively borrowing from the seniors, it becomes clear how the rapid spread of securitization over the last thirty years, but especially over the last ten years, dramatically increased the leverage in the system.

Another factor that dramatically increased overall leverage in the system is the credit default swap, which I discuss shortly.

4.2 Housing and the Double Leverage Cycle

Leverage on houses got to be much higher in this leverage cycle. In the recent leverage cycles, ending in 1994 and 1998, homeowner leverage did not get remotely as high as it did in the recent cycle. In 2006, many homeowners were borrowing with basically no money down, or as little as 3 percent, as we saw in Chart 1.²⁵ New mortgages like option arms were invented, which abetted this mad rush to loan homeowners all or nearly all of the purchase price. Whereas previous cycles' leverage

²⁵ See Haughwout, Peach, and Tracy (2008) for details on leverage used for nonprime borrowers from 2001 to 2007.

involved many financial institutions, it never involved such a large fraction of the general population. When housing prices and securities prices fell, millions of homeowners as well as many of the most venerable financial institutions in America found themselves underwater, owing more money than the value of their assets.

Thus, the current cycle is really a double leverage cycle: not only are the mortgage securities subject to the leverage cycle, but their "fundamental" cash flows (namely, homeowner mortgage payments) are also subject to the leverage cycle. These two cycles feed off each other. When margins are raised on homeowners, it becomes more difficult to get a new mortgage and home prices fall, jeopardizing mortgage securities backed by houses. But more importantly, it becomes more difficult for homeowners to refinance their old loans, putting these loans and the securities they back in much more jeopardy of defaulting. Similarly, when margins on securities are raised and their prices fall, then in order to sell the securities for higher prices, underwriters demand better underlying mortgages, that is, more money down from home buyers.

4.3 Credit Default Swaps

The current cycle has been more violent because of the standardization/creation of the derivative credit default swap market for mortgages in 2005, just at the top of the leverage cycle. One reason for the abruptness of the fall is that CDS allowed pessimists to leverage at just the worst time. Once CDS emerged, they were bound to put downward pressure on prices, because they allowed pessimists to express their views for the first time and indeed leverage those views. Had the CDS market for mortgages been around from the beginning, asset prices might never have gotten so high. But their appearance at the very top of the cycle guaranteed that there would be a fall.

Not only did CDS allow pessimists to leverage for the first time, it also allowed them to leverage more than optimists. When a bond trades near 100, but there is a perceptible chance of a big drop in price, then in a rational world the writer of insurance is almost always going to be asked to put up much more collateral than the buyer of insurance, because his potential liability is so high. A small group of pessimists can therefore have an outsized negative impact on prices by leveraging their CDS positions, since traders on the other side will need far more capital to offset those positions.

A second reason why CDS made the fall much worse is that in practice they allowed optimists to leverage even more than they had before. To the extent that CDS did not lower prices before any bad news, it was because leveraged optimists increased their leverage by taking the other side of the CDS, on

top of their leveraged purchases of the underlying assets. But this made the crash much bigger once the bad news hit. CDS is a kind of insurance market for bond defaults, but instead of cushioning losses, it made them much worse because often the buyers of the bonds did not buy the insurance, they sold it.²⁶

One might mistakenly think that CDS should just wash out. In other words, for every dollar lost on the insurance, there should be a dollar gained by the recipient. But the optimistic writers of insurance are very different from the pessimistic buyers of insurance. When the bad news hits, the former lose and must reduce their purchases of assets; the latter gain, but still will not buy the assets. Writers of CDS insurance expose the economy to the same problems of excessive leverage I described earlier.

This brings us to the question of just how much leverage one could actually obtain via the CDS market. Imagine a bond with \$100 face value that is trading for \$98, and imagine a CDS insurance contract promising \$1 for every \$1 the bond defaults. The \$98 price suggests expected losses to the insurance writer of \$2. If the bond rises to \$99, the seller of insurance effectively makes a dollar and if the bond price falls to \$97, the insurance writer effectively loses \$1. Thus, writing insurance is tantamount to owning the bond. One can therefore compare the collateral a writer of CDS insurance had to put up with the down payment a buyer of the bond would have had to make to see where leverage was higher. It now appears that leverage was higher with CDS. Many firms, like AIG, were allowed to write CDS insurance with little or no initial margin. If enough collateral had been put up by AIG, there would have been no reason to bail it (or more to the point, all its counterparties) out.

The failure of some buyers of CDS insurance to insist on proper collateral from the writers of the insurance was made far worse because the gains and losses from CDS are not netted. A Firm B that was neutral, betting one way against Firm A on tranche BBB, and betting the opposite way on the same tranche against Firm C, could come out a loser anyway. If Firm A defaults on its insurance payment, then B will be unpaid by A but still on the hook for paying C. So instead of just one Firm A going bankrupt and another Firm C going unpaid in the absence of collateral, as would happen with netting, another Firm B might also go bankrupt, closing shop, firing workers, and creating other social costs.

Losses by leveraged buyers of assets can cause a chain reaction when a margin call forces a leveraged buyer to sell, which might lower the price and force another leveraged buyer to sell and so on. But with uncollateralized CDS, the chain

²⁶ Of course, there were undoubtedly some hedge funds that bought bonds they thought were undervalued, and bought insurance on similar bonds in order to hedge their position against the risk of a market downturn. These are the leveraged buyers that survived the crisis without a bailout. AIG is a classic example of a writer of CDS insurance on mortgages that also held mortgage securities (see Congressional Oversight Panel Report, June 10, 2010).

reaction is more direct: Firm B loses the money irrespective of market prices. The implication I draw later is that there are benefits from CDS being traded on an exchange instead of in bilateral contracts, both to ensure that collateral is always posted by the writer of the insurance and to make sure losses are netted.

Another benefit of putting CDS on an exchange would be the ease with which size and leverage could be monitored by regulators. In traditional insurance law, as I understand it, there is a prohibition against overinsuring by taking out insurance for more than the underlying asset, precisely because of the moral hazard such practices entail. Similar prohibitions could be adopted for CDS.²⁷

4.4 Counterparty Risk

In bilateral CDS contracts, it was often the case that the insurer did not post enough initial margin collateral to guarantee payment after a big move in default probabilities. This CDS problem illustrates a more general flaw in the whole system of contracting on Wall Street. These contracts to a great degree were written in such a way that only one side of every transaction was presumed liable to default, so that only the other side needed protecting. For example, in the repo market, a hedge fund borrower gets a loan from an investment bank, and puts up collateral at the bank worth more than the loan. The investment bank is protected against the potential default of the hedge fund, because in that event the collateral can be sold to recover the loan amount. But the contract does not contemplate the bankruptcy of the investment bank. What recourse does the hedge fund have if the investment bank goes out of business, shutting its doors and swallowing the collateral security? Following the Lehman bankruptcy, traders who never before had to give a second thought to these counterparty risk questions suddenly had to reevaluate all their contracts, with disastrous effects on liquidity and price discovery.

Now, this unplanned-for counterparty risk has become the primary rationale for the government's seemingly unending commitment to inject capital into "too-big-to-fail" institutions. "We can't afford another Lehman," is the common refrain; we had to intervene with AIG not because it was so vital, but because if it defaulted a chain reaction might ensue.

The prospective solution to the counterparty risk problem is to ensure that both sides put up enough collateral. Of course, people are now more alert to their counterparty vulnerability than they were before, and thus pressure will grow, for example, on repo lenders to warehouse the

²⁷ See "A Daring Trade Has Wall Street Seething," *Wall Street Journal*, June 12, 2009, about a writer of CDS insurance who found a way to make the bond pay off to avoid paying the overinsurance.

collateral at a third site that would not be compromised by the bankruptcy of the lender. This raises questions about whether there is enough collateral in the economy to back all the promises people want to make, which I discuss at length in Geanakoplos (1997) and Geanakoplos and Zame (2009). But I believe there could be a government initiative to move as many bilateral contracts onto exchanges as possible; agents trading with the exchange will be required to put up collateral, and the netting through the exchange will economize on the collateral. As for any finance-related bilateral contracting so particular that it could not be moved to an exchange, the parties could either accept strict disclosure requirements and limits on how much of this contracting they could engage in or accept doing without the instruments altogether.

4.5 Government Laxity, Deregulation, and Implicit Guarantees Increased Leverage

The mildness and shortness of the crisis stage of the last two leverage cycles, in 1994 and 1998, may have led many people, perhaps including the regulators, to ignore leverage altogether. The abrupt tightening of margins in 1998 was explained by the supposed irrationality of lenders, who it was said reacted by raising margins after the fact, that is, after the fall in prices had already occurred. It appears that virtually no lenders lost money on loans against mortgage securities in that crisis. The run-up in asset prices and home prices during the current cycle was attributed mostly to irrational exuberance, instead of being understood, first and foremost, as an inevitable consequence of the increase in leverage. Partly as a result of this faulty narrative, government authorities did nothing to curtail the dramatic growth in homeowner leverage, or consumer leverage more generally, or corporate leverage, or securities leverage. Banks were allowed to move assets off their balance sheets and thus avoid capital requirements, further increasing their leverage.

Not only did the Fed (and everyone else) react passively to the rising leverage pervading the system, it encouraged the deregulation that unleashed the leverage inherent in outsized credit default swaps. As I mentioned earlier, outsized CDS contracts seem on their face to be either gambling or writing insurance in excess of the value of the property being insured. Under either interpretation, they would have run afoul of state laws prohibiting gambling or overinsurance. Thus, it took a positive act of Congress to pass legislation in the Commodity Futures Modernization Act of 2000 exempting CDS from those limitations.

Perhaps the most important and unwitting government stimulus to the increased leverage was the implicit government

guarantees for entities that were considered too-big-to-fail. Fannie Mae and Freddie Mac grew bigger and bigger. The presumed government guarantee on their promises enabled them to leverage their assets to 30 or more, and still issue debt just above Treasury rates. Without this implicit government backing, they would never have been able to borrow so much with such little capital.

Many investment banks were allowed to write CDS without collateralizing their implicit promises, as I observed before. It seems virtually inexplicable that Wall Street overlooked this counterparty risk; more likely, many counterparties assumed that these firms were implicitly backstopped by the Fed or the Treasury. And indeed, despite some doubts when Lehman collapsed, that expectation proved correct.²⁸

4.6 The Rating Agencies Effectively Increased Leverage

The expansion of the mortgage market into less creditworthy households made it more likely that a shock would someday be “big and bad and scary,” creating more uncertainty and more disagreement. The anticipation of that, however remote the possibility seemed, should have made lenders nervous and caused them to put a brake on leverage. This rational concern was dramatically reduced by a faith many investors had in the rating agencies and their default models, which were widely relied upon by market participants (and the rating agencies themselves), but which failed to account adequately for the probability that defaults in certain circumstances would be highly correlated. Some investors forgot the incentives of the rating agencies and the incentives of many market actors to downplay seriously the probability of highly correlated defaults. In the face of a long history of low defaults and with billions of dollars of deals waiting on the blessing of a small handful of rating agency actors, it would have been astonishing if ratings had been as tough as they should have been. The same lesson applies to the mortgage brokers who were able to collect fees for signing up borrowers without facing any losses themselves if the borrowers defaulted.

4.7 Global Imbalances Increased Leverage

Caballero, Farhi, and Gourinchas (2008), Caballero (2010), and others have suggested that the enormous savings glut

²⁸Bear Stearns was sold to J.P. Morgan, which took on Bear's obligations, but only after the government guaranteed \$29 billion of Bear's assets. Many other investment banks, like Goldman Sachs, were given emergency injections of \$10 billion of Troubled Asset Relief Program (TARP) money.

coming from Asia increased the demand for safe assets. This presented a profit opportunity to American financiers, who were thus stimulated to engineer the securitizations that created apparently safe bonds out of risky assets. It is hard to assess how important this factor is, but surely a gigantic demand for safe bonds would indeed give a big incentive to create those bonds and thus inevitably to concentrate more risk in other bonds. However, that leaves unexplained why investors were willing to buy those other bonds, or why investors bought so much of the new, “safe” AAA-rated bonds even when their yields revealed that the market did not think they were perfectly safe. The Chinese, for example, did not buy these bonds and they did not lose money when they subsequently defaulted. The global-imbalances hypothesis relies on an additional mechanism for its power: global imbalances created lower, truly safe rates, which led American investors pursuing absolute yields to leverage more, for example, by buying the new, “safe” bonds with borrowed money to leverage their tiny excess spreads. Thus, we come back to leverage.

4.8 All Upside Down

The upshot of the huge credit boom and the plunging prices was that an extraordinary number of households, businesses, and banks ended up upside down or underwater, that is, with debt exceeding their assets. According to First American CoreLogic, about 13 million of the 55 million mortgage holders were underwater in early 2010. According to Lender Processing Services, about 2 million families have lost their homes since 2007, 2.5 million more are in foreclosure, and another 3 million are not currently paying their mortgages.

The government has assumed trillions of dollars of mortgage debt through its guarantee of Fannie Mae and Freddie Mac and through its Federal Housing Authority (FHA) loans, and has invested hundreds of billions of dollars supporting banks and firms like AIG; in addition, on account of the huge number of failing banks, the Federal Deposit Insurance Corporation is on the verge of borrowing from the Treasury. A problem of too much private debt has morphed into a problem of too much government debt.

4.9 Why Didn't Wall Street Risk Managers Anticipate the Collapse?

Having discussed many of the factors that exacerbated the crisis of 2007-09, I am now in a position to assess the widely held view that nobody saw it coming.

Nobody doubts that Wall Street understood that there was considerable risk in subprime mortgage pools. That is why they were tranching into different tiers, called AAA, AA, and down to BBB. And these bonds were all senior to residual pieces and overcollateralization, which together provided another 8 percent of protection. So, the question is really not whether Wall Street overlooked the risk, but rather how did it come to be that Wall Street so badly underestimated the size of the risk?

The answer, I believe, is that it was nearly impossible to foresee the devastating consequences of the multiple feedbacks between securities and houses embodied in the double leverage cycle. Complex adaptive systems are notoriously hard to predict. Contrary to the myth that nobody imagined that housing prices could go down as well as up, I suspect that virtually every large bank and hedge fund considered a scenario in which housing prices went down at least 10 percent. Recall that if 25 percent of the loans result in homeowners being thrown out of their houses, with 25 percent losses on each foreclosed home, that amounts to losses of just 6.25 percent = $.25 \times .25$ for the pool as a whole, which would leave the rated bonds unscathed. Better still, if 70 percent of the homeowners refinanced according to historical patterns, then even with 50 percent defaults and 50 percent losses on the remaining 30 percent of the loans, losses would come only to 6.75 percent = $30 \text{ percent} \times .5 \times .5$. But how many anticipated that at the same time as housing prices went down mortgage down payments would rise to the point that subprime refinancing virtually stopped, dropping from 70 percent to zero? Or that subprime mortgage originations would cease, causing further house declines? And that at the same time servicers and banks would refuse to write down principal, leading to more foreclosures and further house declines? And that in the face of so much homeowner misery and the destruction of so much property, the government would wait until March 2009—more than two years after the crash of the subprime ABX index in January 2007—to launch its Home Affordable Modification Program (HAMP)?

5. THE SOLUTION TO THE CRISIS: A MULTI-PRONGED APPROACH

Once the economy is plunged into circumstances as dangerous as we saw last year, the government has no choice but to act boldly. The correct course of action is to reverse the final stages of the crisis and thus stop the panic. At the outset of this crisis, I recommended the three-pronged approach I present here—a thematic solution to the crisis that addresses in order of importance all aspects of the final stages of the leverage.²⁹

²⁹ See Geanakoplos (2008).

As I explained above, all leverage cycles end with 1) bad news creating uncertainty and disagreement, 2) sharply increasing collateral rates, and 3) losses and bankruptcies among the leveraged optimists. These three factors reinforce and feed back on each other. In particular, what begins as uncertainty about exogenous events creates uncertainty about endogenous events, like how far prices will fall or who will go bankrupt, which leads to further tightening of collateral, and thus further price declines and so on. In the aftermath of the crisis, we always see depressed asset prices, reduced economic activity, and a collection of agents that are not yet bankrupt but hovering near insolvency. How long the aftermath persists depends on the depth of the crisis and the quality of the government's response. Whether we find ourselves in a similar crisis in the future depends on whether, understanding how leverage got us here, we adopt reforms that require supervisors to monitor and regulate leverage in good times. First, I take up what government actions could have been taken, and in what order, to address the final stage of the double leverage cycle that the government was called on to address in 2007.

The thematic solution once the crisis has started is to reverse the three symptoms of the crisis: contain the bad news, intervene to bring down margins, and carefully inject "optimistic" equity back into the system. To be successful, any government plan must respect all three remedial prongs, and should be explainable and explained to the public in terms that it can understand. Without public confidence, which can only flow from public understanding, any federal government (hereafter, "government") plan undermines its own objectives and limits its prospects for success. The government's actions thus far have not addressed all three prongs adequately and policymakers have thus far largely failed to explain how their various solutions are tied to the roots of the crisis we face.

Unfortunately, the TARP, the government's first intervention plan to buy distressed assets, was not clearly thought through and neither it, the ostensible solution, nor the problem that required a solution were clearly explained. After its announcement, asset prices fell further. But even now, after the panic has subsided, we must ask who or what is the government trying to save? Many in the public have come to believe it is merely trying to save banks, or some big banks, from failure because somehow their failure would signal a catastrophe for the American brand, to be prevented at all costs.³⁰ The confusion about the government's goals has created its own set of problems, which we can ill afford. Clarifying the government's goals will be harder now, but it remains an indispensable step.

³⁰ "Sixty-seven percent (67 percent) of adults believe Wall Street will benefit more from the new bank bailout plan than the average U.S. taxpayer." *Rasmussen Reports*, February 2009/56.

5.1 Step One—Addressing the Precipitating Cause of the Crisis: "Scary Bad" News (Massive Uncertainty) about Housing and the Assets Built on Housing

To foster recovery from the dramatic final stage of a leverage cycle as large as the one we have just experienced, the government must address the cause of the uncertainty that triggered the end stage. Without that, the efforts taken thus far to bring margins down and recapitalize banks, even had they been perfectly implemented, would not be enough to reverse the cycle and restore the economy to health. In this crisis, with its roots in housing, that means doing something for housing prices and homeowners. This makes undeniable sense in this crisis, not just because addressing the cause of the uncertainty and disagreement (the scary bad news) is critical to reverse any leverage cycle, but because the biggest social losses will probably come from the displaced homeowners. And, of course, the biggest reason for the tumbling mortgage security prices, and the resulting insolvency of the banking sector, is fear that housing prices will keep falling.

Saving the Homeowners: Stemming the Tsunami of Foreclosures to Come

One of the saddest stories in this financial meltdown is that millions of homeowners are being thrown out of their homes for defaulting on their mortgages. Throwing somebody out of his home is tragic for the homeowner, but also very expensive for the lender. One of the shocking aspects of the foreclosure crisis is how low the recoveries have become on foreclosed properties, after expenses. (Interestingly, the mortgage bond index markets anticipated these bad recoveries.) Nobody gains when the homeowners are thrown out and the banks and/or investors collect pennies on the dollar for the money they loaned. Yet, as we saw, 2 million homeowners have already been evicted, another 2.5 million are seriously delinquent and almost surely will be evicted in the near future, and at least another 3 million will eventually default and be evicted if trends continue. Without much bolder action than has thus far been taken by the government, the stream of evictions and bad recoveries for lenders will continue and accelerate, becoming a torrent that will further depress housing prices and impede economic recovery.

Negative equity is a key driver of mortgage defaults. When faced with an income shock, borrowers who are in positive equity have the option to sell the house rather than default. Borrowers who are underwater (in negative equity) may choose to default even in the absence of an income shock.

The connection between LTV and default is illustrated in Chart 8. For each mortgage in the First American CoreLogic LoanPerformance Data Base, the current LTV is estimated by taking the appraisal value of the house at the moment the first loan was given, and then assuming thereafter that the house changed in value according to the Case-Shiller index for houses with the same Zip code.

As the chart shows, homeowners who have positive equity in their homes default infrequently. But for homeowners with negative equity, the rate of default is staggering. For subprime borrowers with a 160 percent loan-to-value ratio (that is, the ratio of all the mortgages on the home divided by the current home price), the default rate is 8 percent *per month*.

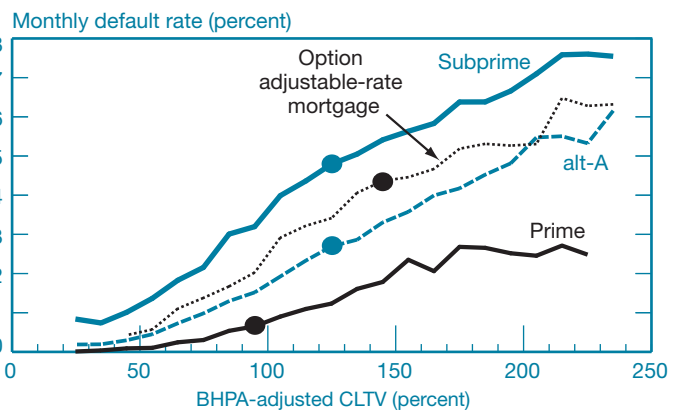
These findings seemed surprising when I first presented them in a *New York Times* editorial written with Susan Koniak on March 5, 2009 (Geanakoplos and Koniak 2009). But nowadays, many other researchers are reaching the same conclusion.³¹ The conclusion is an inescapable matter of incentives. It may not be economically rational for a homeowner to continue to pay off a \$160,000 loan when his house is only worth \$100,000.³² Mortgage loans have turned out to be no-recourse—after seizing the house, the lender almost never comes after the borrower for more payments. Besides the ability to live in the house, the only other thing the homeowner loses by defaulting is his credit rating, but especially for a nonprime borrower with a low credit rating to begin with, how much can that be worth? Finally, a choice today by a negative equity borrower to default may be moving up in time a necessity to default at some point in the future. In this case, the borrower’s credit rating will likely be damaged anyway.

³¹ Haughwout, Peach, and Tracy (2008) stress the importance of negative equity as a determinant of early defaults among nonprime borrowers. The Congressional Oversight Panel cited negative equity as the single greatest predictor of default in its report of March 6, 2009. It included the data I provide here as evidence of this fact, data that I supplied to the Panel in advance of its report, as well as data from an array of government agencies, all of which corroborated the Ellington Capital Management data presented here. That is not to say that joblessness is not now having a significant effect on default rates. It is. But even now, negative equity is the best predictor of default and many Americans with jobs are defaulting, and will continue to default, not just the unemployed. See generally the Congressional Oversight Panel’s Report of October 9, 2009, on the continuing foreclosure problem and the unimpressive results from government foreclosure prevention efforts taken thus far. Finally, to the extent that job loss has become (it was not at the start of this crisis) a significant cause of defaults, strong effective measures to eliminate the scary bad news—that is, efforts to stabilize the housing market—will help the economy recover faster and thus help the employment rate.

³² The implication of this statement is that the HAMP plan of reducing interest rates to lower mortgage payments to homeowners who are underwater is, at least for those seriously underwater, an invitation or encouragement to act in a manner that may make no or little economic sense, that is, stretching to make mortgage payments, albeit lowered from their highs, on homes those people will never own when many of them might be able to rent more cheaply.

CHART 8

Monthly Net Flow (Excluding Modifications) from Less than Sixty Days to Sixty or More Days Delinquent Based on Performance from November 2008 to January 2009 for All Deals Issued in 2006



Note: Circles indicate median combined-loan-to-value (CLTV) ratios by product.

Foreclosures are horribly expensive for the lender. At the present time, subprime lenders collect about 25 cents per dollar of loan when they foreclose. For example, if the loan is for \$160,000 and the house has fallen in value to \$100,000 and the homeowner defaults and is evicted, the lender can expect to get back \$40,000. It takes eighteen months on average to evict a homeowner, and during that time he does not pay his mortgage or his taxes, the house is often left empty and vandalized, a realtor must be hired to sell the house, and so on. Of course, the main reason the average recoveries are so low is that the defaulters are the homeowners who are furthest underwater (see Chart 8).

In a rational world, many foreclosure losses would never happen. The lenders would renegotiate the loans by reducing the principal so the homeowners could pay less and stay in their homes, and the lenders would actually get more by avoiding the losses from legal fees and bad home price sales. If the above loan were written down to \$80,000, the homeowner would likely find a way to pay it, or else fix up the house and sell it for \$100,000. Either way, the lender would get \$80,000 instead of \$40,000. That would have the further benefit of keeping many homes off the market and thereby aid in the stabilization of home prices.

The Home Affordable Modification Program pays servicers to temporarily reduce interest payments and to extend the term of the mortgage in order to reduce the monthly payments on the mortgage, but does not incentivize servicers to cut principal. Cutting monthly payments by half will temporarily reduce the homeowner’s payments by the same amount that cutting principal by half would. But under the government’s plan, the

cut is temporary, not permanent, and thus is likely to lead to many more defaults in the long run than cutting principal would as soon as the interest rate goes back up.³³ In fact, since the homeowner will still be underwater, he will not in any meaningful sense own his house. He will be less likely to make repairs, he will not be able to give the house to his children, he will not be able to sell it if he gets a job in another city.³⁴ In short, there is every reason to think he will likely default even before the interest rate goes back up. For loan modifications where there is no principal reduction, the redefault rate is above 50 percent within nine months.³⁵ Indeed, because the government's present plan allows servicers to increase principal while cutting interest by adding fees and other costs to the old principal amount, the plan is likely to leave more homeowners underwater than there would be absent the plan and others more deeply underwater—that is, with even less chance of ever owning their homes and thus less incentive to keep up with mortgage payments—than they would have without this government “rescue” plan.

HAMP started off slowly and only recently is beginning to be able to process a larger flow of mortgages. In the first six months of the plan, according to the Congressional Oversight Panel's October 2009 report, only 85,000 mortgages had been modified, and of those only 1,711 were “permanent” modifications (that is, permanent/temporary, since interest rate reductions under the plan are designed to end in a few years), and of those only 5 involved principal reductions.³⁶ As of May 2010, HAMP had started trial modifications on 1,244,184 loans, of which 429,696 had been canceled and 340,459 had been converted into permanent modifications. Again, virtually none of the permanent modifications involved principal reduction. Of the 5.7 million loans that were delinquent sixty or more days in May, only 1.7 million were eligible for HAMP modifications.

³³ Haughwout, Okah, and Tracy (2009) find in a sample of pre-HAMP subprime mortgage modifications that reducing principal is twice as effective as cutting the interest rate in terms of reducing the post-modification redefault rate.

³⁴ See Gyourko and Saiz (2004).

³⁵ See “OCC/OTS Mortgage Metrics Report,” 2Q 2009.

³⁶ To be clear, my criticism of HAMP is not based on the number of the time-limited “permanent” modifications completed, but rather is centered on the near-exclusive concentration on interest reduction and, as I explain in the text below, on leaving the servicers in charge of the modification decision. I could find no updated information in the report on how many, if any, of the trial or permanent modifications involved principal reduction as opposed to interest reduction, and I have no reason to assume that the percentage of modifications with principal reductions has increased. It is also worth noting that in the Congressional Oversight Panel's Report of October 2009 (p. 127), the Panel notes that the apparent rise in modifications due to the administration's plan might be overstated, as there was some evidence of a “substitution effect,” that is, the number of “voluntary” modifications by servicers (or modifications made outside of the administration's plan) went down in the first six months of the plan, suggesting that the gross number of modifications attributable to the plan itself might be exaggerated. The new report by the government does not provide data from which one can assess any substitution effect.

The design of any modification program must recognize that the servicers have incentives that at times put them at odds with bondholders and homeowners, so that they may actually prevent modifications that would help lenders and homeowners but hurt servicers. In the case of many nonprime borrowers, the loans have been pooled in a trust, and their principal has been tranching into many different bonds, each held by a different investor. The lenders are the bondholders, but they are numerous and dispersed and by contract have given up the legal right to renegotiate with homeowners, delegating that right to an agent.³⁷ That agent is the servicer, who has a fiduciary responsibility to act in the interests of the bondholders in the trust.³⁸ In “normal” times, this arrangement worked tolerably enough. But in this crisis, with so many mortgages in or near default, it has failed miserably for at least four reasons, all traceable to a misalignment of interests between servicers and those whose interests they are supposed to protect, which has now ruptured with terrible effects.

First, modifying loans is a time-consuming and expensive operation. The servicers who have the legal right to make modifications do not get paid directly for improving the cash flows to loans. It is generally cheaper for them to move into foreclosure. In particular, they have no incentive to set up the huge infrastructure and to hire and train the extra staff required to make sensible modifications on a grand scale.

Second, modifying the loans has different effects on different bondholders. It has proved difficult to modify loans in a way that pleases everyone. The servicers say they are terrified of lawsuits from the bondholders if their modifications help most bondholders but hurt others. For example, writing down principal immediately may make more money for the trust as a whole, but it would immediately wipe out the BBB bonds and possibly other lower level bondholders. Letting the borrowers remain in their houses without paying during the foreclosure process means that during all that time all the bondholders, including the BBB, get their coupons paid in full from servicer advances. The servicers then recoup their advances, at the expense of the trust, when the house is finally sold.³⁹ In reality, servicers

³⁷ It should be noted that this right was given up to avoid the collective action problems inherent when the lenders are numerous and dispersed, and thus was given to a third party (the servicer) to be exercised on the lender's behalf, the servicer acting as a fiduciary for the lenders. It was not given to the servicer to be used to benefit the servicer's interests at the expense of the principals (the lenders), and using the discretion to modify or foreclose that way is self-dealing on the part of servicers and a breach of their obligation to the lenders.

³⁸ See Alan Kronovet, “An Overview of Commercial Mortgage Backed Securitization: The Devil Is in the Details,” 1 N.C. Banking Inst. 288, 311 (1997), explaining fiduciary duties of servicers. Section 1403 of the new housing bill that was signed into law on July 30, 2008 (HR 3221, the Housing and Economic Recovery Act of 2008, P.L. 110-289), lays out the fiduciary responsibilities of servicers of pooled mortgages.

³⁹ This requires that the servicers have access to capital to finance the coupon payments until the foreclosure process is concluded.

were not deterred only by potential lawsuits. That was revealed when Congress passed legislation that freed servicers from lawsuits by bondholders.⁴⁰ Principal reduction modifications did not follow. To put it all another way, there is a complex negotiation that is not taking place, and the government needs to intervene to break an impasse for the public good.

Third, now that HAMP, which is based on interest reductions, has given the servicers cover to reduce interest instead of principal, they can be counted on to do the former and eschew the latter. Cutting the principal by half, for example, immediately reduces the servicer's fee by half (since the fee is computed as a percentage of principal), while cutting interest does not. Moreover, cutting principal increases the likelihood that the homeowner will sell or refinance, which would cause the servicer to lose his fee entirely.

Fourth, the biggest servicers happen to be owned by the biggest banks, which in turn own a huge number of second-lien loans. Cutting principal on first loans almost implies cutting the principal drastically, if not to zero, on second loans. But that would mean that the banks could no longer hold the second-liens on their books at potentially inflated prices. The banks want desperately to postpone the write-down of those second-liens, which is to say, they have yet another powerful motive not to do what is in the interest of lenders, homeowners, and the economy as a whole: reduce principal on the first-lien loans they are servicing. By contrast, cutting interest on first-lien loans makes it easier to justify carrying the second-liens on bank balance sheets at higher values for the near term (which is what matters to the banks), as homeowners are more likely to be able to make the lower monthly payments (from lower interest rates) than their original payments, at least in the short run.⁴¹

Another indication that servicers have bad incentives is that when the big banks hold the same kind of loans in their private portfolios, they do reduce principal. During the second quarter of 2009, 30 percent of all modifications done to loans directly held in bank portfolios involved some principal reduction. During that same quarter, the servicers reduced principal on 0 percent of their loan modifications, as did the government-owned agencies Fannie Mae and Freddie Mac.⁴²

Loans that have not been securitized and are held entirely by banks (whole loans) are also not being written down fast or

far enough.⁴³ The pathology this time is, if anything, more distressing. It appears that the banks, abetted by the suspension of mark-to-market rules, are unwilling to fully recognize the losses that have occurred on their residential mortgages.⁴⁴ They may prefer to keep a mortgage on their books at \$160,000, even though it will eventually bring them only \$40,000, than to reduce the principal to \$80,000 and mark the loan at this value today. The suspension of mark-to-market rules has also fed the pathology discussed above on second-liens. Perpetuating a conflict between the economic value and the accounting value of an asset is bad government policy when it leads to actions that further reduce the asset's value. This conflict is also obscuring the value of bank assets, many of which are being guaranteed by the government, and thus in turn obscuring the value of mortgage assets now owned by the government. In my terms, this only ensures the continuation of "scary bad" news (uncertainty), when the goal should be for government plans to clarify the situation (the value of assets) that keeps leverage severely constricted.

Insuring that economically efficient mortgage modifications are made for borrowers can be greatly facilitated by placing the decisions with impartial agents. In October 2008, Susan Koniak and I urged the government to take the reworking process out of the hands of the servicers and put the decision into the hands of government-hired trustees. In our approach, the government-hired trustees would be told only about the homeowners, and would be blind to the bonds built atop the loans. Their job would be to choose modifications or foreclosure, whichever they judged would lead to the greatest recovery *for the lenders* on the original loan. They would thus be carrying out the duties of the servicers exactly as they were intended, but free from the conflicts of interest and perverse incentives that have prevented the servicers from carrying out their mission.⁴⁵

If there is a second-lien loan, the government trustees would make the same calculation, deciding what modification, if any, would maximize total revenue. If this involved reducing principal, then the second-loan principal would be reduced to

⁴⁰ See Section 201 of the Helping Families Save Their Homes Act of 2009, preventing lenders/bondholders from suing servicers who modify mortgages under a qualified mortgage modification plan, which is defined in the Act broadly enough to include all economically sensible modifications, that is, those with a reasonable prospect of returning more money to the lenders than a foreclosure.

⁴¹ Cutting the monthly payments will also push the likely default further into the future. Under current accounting rules, this reduces the loss reserves that the banks have to hold against these loans.

⁴² See OCC/OTS Mortgage Metrics Report, Q2 2009.

⁴³ At first, it appeared that they were not being written down at any greater rate than securitized loans, although the data are not perfect on this. Foote et al. (2009) argue that this showed there was no real incentive to write down loans. Now, again based on imperfect data, there seems to be some evidence that principal on whole loans, at least at some banks, is being written down more often than principal on securitized loans (which effectively never see reductions in principal), although reductions in principal on whole loans are still much less frequent and much less widespread than one would expect to see given the economics of the situation, that is, that reducing principal for many underwater homeowners will yield much more money than foreclosure or (over the long term) interest reductions.

⁴⁴ Banks may also still be holding out for some more direct government subsidy for their failing whole loans, either through government assumption of the mortgage risk or some other form of direct payment for anticipated whole loan losses.

zero. The second-loan holder could still receive some cash, however. I would recommend distributing the same percentage of the monthly payments to the second loan as it was getting before principal was reduced for a period of, say, two years. After that, the second loan would be completely extinguished and all cash flows would flow to the first-loan holder.

For a vast number of homeowners now upside-down in their mortgages, that is, owing more than their home is presently worth, this process would likely result in a reduction of principal. Why? Because reducing principal rather than cutting interest rates would be more effective at preventing defaults and would yield investors/lenders more money than foreclosing, as we have seen.⁴⁵

If the government handled this correctly, most homeowners who were unable to pay the original loan but were willing and able to pay a modestly lesser amount would get to stay in their homes, the bondholders collectively would get more payments than they are currently expecting (though some tranches would be hurt), and the government would not have to invest any capital.

This plan is not the same as “cramdown” in bankruptcy, which Congress has thus far rejected and which entails costs and creates some perverse incentives that my plan avoids. Giving reductions in principal through bankruptcy (assuming the law were changed to allow that) would encourage homeowners now current on their mortgages but underwater and thus likely to default sometime in the future to default immediately to support their petition for bankruptcy relief. However, my plan, as originally conceived, does not build in any incentives for the borrower to default in order to increase the chance that the mortgage will be modified. Principal reductions would be done first for homeowners who have not defaulted yet, and only later for homeowners who have defaulted under some special hardship. It would give underwater homeowners now holding on for the short term a continued incentive to keep paying until the government trustees could evaluate their loans and circumstances for a reduction in principal. Second, my plan differs from bankruptcy in that it does not subject homeowners to the shame and devastating harm to future credit and thus to their economic circumstance that a bankruptcy proceeding entails. Third, my plan contemplates putting local housing market

⁴⁵ See Geanakoplos and Koniak (2008). Under this plan, the servicers would still collect the servicing fees they do now. They would continue their duties of sending letters to homeowners, collecting the monthly payments and distributing them to bondholders, evicting homeowners who did not pay, selling their homes, and so on. The only change is that the mortgage loan modification would be taken out of their hands and put into the hands of the government trustees. This reassignment of a particular duty in the contract is not a “takings” from the servicer, among other reasons because the servicers have failed to carry out their fiduciary obligations to the bondholders who employ them to get the most possible value out of the loans. See Dana (forthcoming).

⁴⁶ See Haughwout et al. (2009) for evidence based on subprime modifications.

experts and community bankers in place as government trustees, not bankruptcy judges who are neither numerous enough to handle the number of defaulting homeowners who should justifiably qualify for principal reduction nor as knowledgeable as the personnel I would put in charge.⁴⁷ If my plan were indeed up and running, bankruptcy might be something worth considering as a true last resort for those already deeply in default. Finally, bankruptcy involves all kinds of hidden costs, like lawyer fees and trustee expenses (on top of the costs associated with the experts required to advise the bankruptcy judges) that are unnecessary and wasteful for the vast majority of homeowners and lenders who should be able to make a win-win deal without incurring those costs.⁴⁸

My original plan called for legislation to cut through the agency-problem mess in securitized pools of mortgages by eliminating contract provisions in pooling arrangements that now enable servicers to act contrary to the interests of the investors that the provisions were originally designed to protect. Thus, I envisioned that the government trustees would only be empowered to modify securitized mortgages. This would leave unsolved the problem of whole loans that banks are still refusing to modify sensibly, by writing down principal for underwater homeowners.

I believe, however, that once a government program of modifications for securitized loans proved its worth by resulting in more recovery for investors, banks would be likely to adopt similar standards to modify whole loans. Nonetheless, a solid government plan to force sensible principal reductions for securitized loans would, I believe, go a long way toward convincing the banks that no better deal from the government was forthcoming, particularly if the government clearly articulated that this was so, and would exert discipline on the valuation of the whole loans and second loans on the banks’ balance sheets. Obliging the banks to mark to market would, of course, also push them to get the most value out of their loans by writing down principal for underwater homes.

Finally, what if home prices vastly appreciate by the time the homeowner sells his home? To prevent unwarranted windfall profits to homeowners, the government plan could easily require the homeowner to share 50/50 with the lenders any appreciation in home price up to the full amortized value of the original mortgage, and the plan might even provide that, for houses sold for more than the original loan price, lenders receive a greater percentage of the appreciation.

⁴⁷ Indeed, it is highly doubtful that our bankruptcy courts could handle the job Congress would be giving them if so-called cramdown legislation were adopted, at least not if it were adopted without first having a plan like the one I propose up and running to handle the vast majority of underwater homeowners.

⁴⁸ My plan envisions the government paying for the trustees (community bankers) to decide on whether principal modification would bring in more for bondholders than foreclosure, but I estimate that government expenditure should come to less than \$5 billion.

A Floor to Housing Prices and Restarting Private Lending on Mortgages: Government Equity Stake in Homes

There are at least four reasons to support housing prices directly, in addition to doing so through effective foreclosure relief. First, if housing prices held firm, fewer homeowners would be underwater; thus, more would have an incentive to make their payments. That would keep them in their homes. Second, firm housing prices would staunch the losses on mortgage securities even if there were foreclosures. Third, once there is a floor to housing prices, pessimistic lenders would be relieved of the disaster scenario for many mortgage securities, and margins on mortgage securities would come down significantly, enabling optimistic buyers to purchase them using leverage, pushing up the price of mortgage securities.⁴⁹

Fourth, the leverage cycle is less severe for housing than for mortgage securities, so it can be fixed more easily by government intervention, because home buyers generally lock in their loans and leverage for the duration of time they live in the house. Only new buyers of homes, and those who want to change homes, need to confront the tougher margins. Existing homeowners cannot be forced to put more money down, whereas mortgage security holders who borrowed on one-day repos have found that they now face tougher margin requirements that involve putting more money down. Thus, there are fewer homes in play than there are mortgage securities.

The government has recognized the need to try and support housing prices. A concern is that the measures taken will expose the government to the risk of billions of dollars of future losses, in addition to substantial current costs, while leaving private mortgage lending dead in the water. We simply cannot sustain a situation where all mortgage lending is done by the government. The plan I propose helps to stabilize housing prices and to reinvigorate private lending. And in the long run, it may cost the government much less, possibly even making money.

Current government FHA policy is to make mortgage loans with as little as 3.5 percent down. In addition, borrowers can finance some of their closing costs as well as the up-front mortgage insurance premium. As a result, the effective LTV on new FHA mortgages can exceed 100. These homeowners start with little incentive to continue making payments, particularly in rough economic times. Given the transaction costs of selling a house, absent a rise in housing prices these borrowers will remain underwater and thus create a new source of future defaults. This policy is a repetition (albeit on a smaller scale) of

⁴⁹ As I discuss below, margins must in the future be monitored by the Federal Reserve to assure that they do not once again get excessively low, precipitating another massive and dangerous leverage cycle.

the low down payment lending practices that got us here. It exposes the government to a huge risk of default, and does nothing to stimulate private mortgage lending.⁵⁰

The government has also tried to stabilize housing prices through its efforts to keep mortgage interest rates low and thereby encourage purchases and refinancing. To this end, the Federal Reserve's Large-Scale Asset Purchase program has purchased \$1.25 trillion of agency mortgage securities. Like the HAMP modification program, this choice reflects once again a concentration on interest rates rather than on the collateral (leverage) effects that are at the core of my argument. The Large-Scale Asset Purchase program appears to have lowered mortgage interest rates, but surprisingly few homeowners were able to take advantage of the lower rates by refinancing because they could not come up with a down payment and/or their credit had deteriorated.⁵¹ One might worry that as the purchases wind down, mortgage rates may go back up.

A third government initiative is to give an \$8,000 tax credit to buyers of homes. This tax credit does appear to have been more successful at stimulating home purchases. But the tax credit has no upside for taxpayers and it does nothing to reinvigorate private lending since most of the new mortgages were guaranteed by the FHA. If \$8,000 were spent on 7 million homes, the cost to taxpayers would come to \$56 billion. By contrast, the equity stake plan I propose below is a purchase of value for value; in the long run, it may cost nothing and actually have upside for taxpayers. It should also stimulate demand, and it would reinvigorate private mortgage lending.

As I observed earlier, toughening margins have affected housing prices, because many homeowners can no longer put up the cash payment needed to buy new homes. New homeowners are being asked to put as much as 30 to 40 percent down if they cannot get a government loan. The government could stimulate demand for new purchases, and also mitigate the margin problem, by offering to buy a 20 percent equity stake in any new home purchase (under some maximum price, as with agency conforming loans). Thus, suppose a house is purchased for \$100. The government pays \$20 and gets a 20 percent equity piece, which it collects whenever the homeowner sells. If down the line, the house sells for \$200, the government gets \$40. The government is thus earning the home price appreciation on its piece, without having to bear the expense of maintaining the house. The homeowner gains

⁵⁰ For more on FHA risk, see Aragon et al. (2010).

⁵¹ See Caplin, Freeman, and Tracy (1997) for a discussion of down payment constraints on refinancing and Peristiani et al. (1997) for a discussion of credit constraints. To address this concern, the administration started the Home Affordable Refinance Program, which allows borrowers with prime mortgages to refinance with current LTVs as high as 125. In addition, the FHA introduced a "streamline refinance" program for borrowers with high-LTV FHA loans to refinance to a new FHA loan.

because he gets to live in the whole house while paying for only 80 percent of it. If the home buyer needs a loan to get the house, the government equity piece reduces the down payment the buyer must make, and the ongoing mortgage payments he must make. And if we make the government's equity piece the second loss piece, it leaves the lenders in a very, very safe position, encouraging lending. In effect, it lowers the margin to the borrower, and raises the margin of safety to the lender. Here is how it works.⁵²

Under the plan, the home buyer who wanted a loan to purchase the house would be allowed to borrow at most 80 percent of the \$80 of the house he bought, or \$64. He would have to put up 20 percent x \$80 = \$16 of his own cash. The homeowner would then have a big incentive to make his payments. If he walks away from his debt, he can save \$64, but he has to give up living in a \$100 house on which he had an \$80 ownership share. But if the borrower does default, and if the lender has to foreclose, the lender would be able to collect his debt out of the house sale proceeds ahead of the government equity piece. The government would collect next, and lastly the buyer would get any leftover cash. If the house sold in foreclosure (net of expenses) for \$82, the lender would get his \$64, the government would get \$18, and the homeowner nothing. The effective margin for the homeowner is thus 16 percent on the asset price of \$100, but the margin of safety for the lender is 36 percent. This should make the lender feel very safe and encourage private lending on mortgages. The homeowner's down payment of 16 percent on the total home price is about half the down payment many nongovernment lenders are demanding now. On top of that, the new buyer's mortgage payments would be 20 percent lower than before, because he would be paying on a loan of \$64 instead of \$80.

What about the costs of my plan? Last year, there were 5.5 million new home purchases, down from a high of 7 million. Even if the government had to buy the equity in the entire 7 million, at an average home price of \$200,000, it would cost \$280 billion. But the government would own equity, and be protected by the homeowner's down payment. Housing prices would need to fall another 16 percent before the government lost equity value. As housing prices stabilized, the government would gradually phase out the program, in all likelihood in a year, at most two, after adoption. To lower the government's overall equity investment, the program could be limited to first-time home buyers.

⁵² Equity sharing arrangements could also form with private investors. For a discussion, see Caplin et al. (1997).

5.2 Step Two—A Fed Lending Facility to Help Restore Reasonable Leverage

The most easily implementable step and the second priority, after addressing the source of the uncertainty (the scary bad news), in responding to the final stage of any leverage cycle could be government action to decrease astronomical collateral rates. Thus, in October 2008 I suggested that the most immediate step the Federal Reserve could take was to lend money using the so-called troubled assets (those that suddenly became nearly impossible to use as collateral, as I explained earlier) as no-recourse collateral. I suggested 50 percent margins on average, a reasonable halfway level between the 5 percent margins required at the peak of the leverage bubble and the 70-90 percent margin rate demanded in 2008. The Asset-Backed Securities Loan Facility (TALF) and the Public-Private Investment Program (PPIP), announced in early 2009 at what turned out to be the bottom of the price cycle, embody the spirit of my recommendation. Indeed, the PPIP did lend on these bonds at exactly 50 percent margins. The turnaround of prime mortgage security prices (displayed in Chart 2) after these programs were announced seems to me to be some evidence for the wisdom of the intervention. But in terms of some important details, those programs did not go as I would have recommended. In any case, it now appears that having achieved their purpose, they have been drastically attenuated.

Lending with smaller margins (haircuts) than the market is willing to offer to borrowers who might not repay is a great departure from the traditional role of the Federal Reserve. The orthodox view is that the Fed injects liquidity into the system by lending money to banks and others with impeccable reputations for repaying so as to reduce the riskless rate of interest on very short-term loans. The banks would then presumably turn around and relend that money to investors, at a lower interest rate than would have obtained absent the Fed's intervention. However, the great bulk of lending in the investment world is not based on the reputation of the borrower but based instead on the value of the collateral. The lesson of the leverage cycle is that when lenders demand too much collateral for their loans, liquidity dries up. The Fed cannot undo this by making riskless loans at a lower interest rate than the market, because in liquidity crises it is not the interest rate the banks charge that impedes investor borrowing but rather the amount of collateral they require. The Fed needs to step around the banks and make risky loans directly to investors with smaller haircuts than the market demands, if it is to have the desired effect.

The mechanics of such a massive lending program require some careful thought, but nothing compared with the

difficulties of directly buying. The Fed could simply announce that any arm's-length buyer of any designated security could, at the moment of purchase, take that security to the Fed and receive a five-year loan of 50 percent of the price in exchange for putting the security up as collateral. The Fed would not need to price the security itself. The market would have just done the pricing. With a 50 percent margin, the government money is still quite safe. Remember, the 50 percent loan is against the price the securities will be traded at, not against the original price when issued. The government could thereafter monitor prices, periodically demanding more cash from the borrower to maintain its 50 percent margin, which would make the government lending safer and more responsible.⁵³ Monitoring the collateral price is a much easier job than deciding the price to buy, since there is a 50 percent margin of error: the price monitoring only has to be half right. And the government could consider charging a slightly higher interest rate than the fed funds rate or discount rate, thereby potentially making a profit for taxpayers. That would also make the program easier for the public and politicians to accept.

Needless to say, the 50 percent margin cannot be applied to all bonds. Some bonds have such high volatility in their cash flows that even a 50 percent margin is unsafe. Other bonds can safely be leveraged much more. The Fed must exercise its own expertise in setting these margins, as I discuss later. But in a crisis, they should be set at levels substantially more generous than the market is offering, and significantly less generous than the market had been offering in the ebullient stage before the crisis.

The five-year term can also be chosen flexibly. But it is important that there is a longish term commitment to borrowers that the loan will not be pulled from under them. The last thing a buyer wants to do in a crisis is leverage to buy and then have his financing pulled, or his margins increased. Of course, the Fed needs to worry about its exit strategy; if it lends too much money long term, it will not be able to reel it all back in should inflation pick up. However, by lending at margins and interest rates that are favorable in the crisis but that borrowers will find onerous once markets pick up, and by making margin calls, the Fed can count on most borrowers refinancing their loans privately once the market heats up.

The government might even arrange all this lending without having to come up with the money. Under this alternative, the government could loan slightly less, say, 40 percent, and give up the right to make margin calls. The loan could then be securitized, guaranteed by the government, and sold off to the private sector. With the government guarantee, the money would easily be raised. Or even more directly, for some bonds where this makes sense, the government could simply

guarantee a certain percentage of the principal payments. Private lenders could then lend this much without any risk of default. Of course, on some securities the government might be able to lend much more than 40 percent and still regard the money as safe.

At 50 percent margins, buyers would be able to purchase securities using only half the cash they need to put up at the bottom of a cycle when margins might become 100 percent. Aside from allowing investors' own cash to go further, this borrowing allows investors to earn leveraged returns. If they think the security trading for 60 might only rise to 66 in the near future, they can buy it with 30 down and earn a return of 20 percent when it rises to 66 instead of a return of 10 percent. Buying will be stimulated and the depressed prices at the bottom of the leverage cycle will be pushed back up. Again, with this potential for private profit, the program would make more political sense if a somewhat higher interest rate for the loans were charged, thus building in a real chance for taxpayer profit.

Lending is better than the government's first (and quickly shelved) idea, as proposed by former Treasury Secretary Henry Paulson, of buying up the "troubled assets." As I explained in October 2008, lending against collateral does not require the government to choose what prices to pay, as it would have to if the Treasury directly bought securities. Moreover, lending, unlike buying, is direct action to restore leverage and restoring leverage is the thematic solution to the leverage cycle crisis. It is not some stop-gap band-aid invented only under the pressures of the moment.

Further, lending puts taxpayer money at far less risk than buying does. Assuming the Fed lends at 50 percent margins, every dollar the government lends using the targeted assets as collateral will necessarily be matched by money the investor spends on those assets. The government can say its money is being leveraged. The investors who avail themselves of the government lending will still have their money at risk. Because these investors, and not the government, will do the buying, there is little, if any, chance that this action will push prices to outrageous levels and enrich undeserving sellers.

The Fed has boldly gone a long way in this direction, further than any previous Fed. Through the TALF and the PPIP, the Fed and the Treasury, respectively, have indeed embodied many of these ideas. The PPIP lends at 50 percent margins on troubled mortgage securities, just as I recommended. Its announcement, I believe, played a pivotal role in starting what is now more than a year-long rebound in security prices. Given the condition of the asset markets in early 2009, the rebound in prices seems almost miraculous, and in many ways one must judge the TALF/PPIP a resounding success.

Nevertheless, I believe that the Fed-Treasury leverage intervention would have been better if it had been implemented somewhat differently. This difference is

⁵³ Even if the securities gradually lost all their value, the Fed would still not lose any money if it made frequent margin calls.

important to bear in mind not just for this crisis, but also in case there is another crisis in which prices do not rebound as quickly after a leverage intervention. In my opinion, the two programs did not encompass a wide enough set of assets or a wide enough set of borrowers, they took too long to get going, and in some cases TALF actually took leverage up almost to the crazy levels it had been before. Had TALF started earlier, and had it lent on more assets, it would not have been forced to give such high leverage on the narrow band of assets it did lend against.

In the emergency stages of the leverage cycle, the Fed should have extended lending on more kinds of collateral. TALF restricted leverage mostly to new securities, or to securities that were still AAA-rated. As more and more mortgage securities get downgraded below investment-grade status, they lose their ability to be used as collateral even in the private sector. Lending against the most toxic securities is actually necessary to maintain their value.⁵⁴

The TALF program made government loans on new credit cards, auto loans, college loans, and other securitizations at 20 to 1 leverage. In my opinion, this repeats the error of the FHA mortgage program, lending at the same inflated leverage that got us into trouble in the first place. The Fed has rightly observed that propping up new security values is more important than propping up legacy security values, because new securities represent new activities. When new prices go down, new securities are not issued and the underlying activity for which the securities would be issued (students going to school, cars being purchased, new houses being built, consumers buying with credit cards) stops. However, as I argue more formally in Geanakoplos (2010), in the depths of the leverage cycle, the Fed could raise the price of new securities further by leveraging them less, if it would also leverage the legacy securities to modest levels. The reason is that potential buyers of these new securities are tempted instead to put all their capital into the depressed legacy assets where they are nearly sure of a high return. This indeed is one of the main reasons banks stop lending to businesses or homeowners: they can get better returns by buying depressed legacy assets. Given the depressed legacy security prices, the only way TALF could redirect this private money into new securities was by giving

⁵⁴ Again, such lending would be much less risky if the government had adopted a sensible plan to staunch foreclosures and stabilize housing prices, such as I have just outlined, because such a plan would reduce the toxicity of the securities at issue. And the quicker the government moves to do that, the less risky such lending will become, not to mention the good it would do for the value of the toxic securities the government now owns through one program or another or now guarantees, representing continuing and enormous government money still at considerable risk. This point is why I stress the importance of understanding the nature of the crisis in crafting sensible solutions and how failing to address one part of the problem, in our case the failure to adequately address housing, limits the good that otherwise sensible programs might make.

leverage on the new securities at astronomical 20:1 ratios. If instead the Fed would give much lower and safer 2 to 1 leverage on the legacy assets, it would raise the legacy asset prices, and thus even the new security prices, because it would remove the bargains investors are seeking in the legacy assets.⁵⁵ The new assets would not need so much leverage, and the risk to the taxpayers would be reduced. This would also go a long way to solving the bank lending problem. As I show again in Geanakoplos (2010) (in a stylized example, to be sure), despite lending on a much larger scale, by allowing leverage at 2 to 1 on a wide array of assets rather than at 20 to 1 on a narrow set of assets, the Fed could actually reduce its expected defaults while increasing the prices of all the securities. A year later, it now appears that the Fed will not face significant losses on these TALF loans, and private leverage is also returning. But had things gone worse, the Fed might have been stuck with some dangerous loans.

In the crisis stage, the Fed needs to go around the banks and lend directly to more investors. In theory, the Fed could make no-recourse loans only to a few banks, who would turn around and relend to everyone else. But the banks are nervous about showing too much lending on their books, they ask for too much collateral, and now the Fed is giving them more profitable ways to make money than by lending; so the Fed must reach out directly to more borrowers. Curiously, the PPIP has been restricted to ten potential borrowers/investors, making its scope and size in the end less than what was anticipated. Also, with only ten investors taking government money, the potential for conflicts of interest seems very high, as I discuss later.

The TALF and PPIP programs took too long to get up and running. Hopefully, at the bottom of the next leverage cycle, or even earlier, similar programs could be implemented sooner. I recommend that the Fed keep a standing, permanent lending facility up and running. In normal times, it would lend a little bit across a wide range of assets, to be ready to spring into action if private collateral rates became too high. This facility could be administered directly by the Fed, by people it hired, or it could be run through the repo desks of the Wall Street banks. In the latter case, it would be wise to insist that the banks put some of their capital at risk along with the Fed money. The advantage of using repo desks is that they are already staffed with trained personnel, who have great expertise in making margin calls. Duplicating that expertise would be expensive.⁵⁶ The advantage of a permanent facility is that the Fed would be ready to quickly lend on a grand scale, on many securities, and to many lenders, in the next crisis.

⁵⁵ Another reason why it actually could raise new security prices is that by leveraging the legacy securities at 2 to 1, it will free some investor equity to put into the new securities.

⁵⁶ I presented this proposal for a lending facility to the Liquidity Working Group at the Federal Reserve Bank of New York in early 2009.

5.3 Step Three—Restoring “Optimistic” Capital

Lending will not by itself bring the prices of assets to their old levels (which is okay, given that “old” values were inflated by excessive leverage, as I have explained). But that means that the most optimistic buyers, unfortunately including some of the biggest and most prominent financial institutions in America, have irretrievably lost a huge amount of capital. Not only is their capital no longer available to spend on these securities, but similarly the money they borrowed to spend on these securities has also disappeared.

The most obvious thing the government could do, it did: inject money into financial firms. The idea was that then the firms would continue to function as optimistic buyers and their workers would not join the ranks of the unemployed. But the main problem with the way the government injected capital is that this injection of capital was not coordinated with vigorous programs to address the two other prongs of the end of any leverage cycle: the source of the scary bad news (here, housing) and the precipitous drop in leverage, which I have just addressed in my discussion of Fed lending.

In the absence of vigorous programs to address the first two prongs of any leverage crisis, injecting capital does nothing but push an ultimate reckoning down the road. Without steps one and two, the true financial status of our financial institutions is unknown and unknowable because there is no reliable way to price many of the assets they hold. The danger is that the injection of new capital keeps the banks from failing immediately, but it is not enough to restore their previous activities, leaving them in a kind of limbo and actually creating more uncertainty in the system about whether they will survive. As long as no one knows whether and to what extent our biggest financial institutions are sound, our economy cannot recover.

Bailouts with Punishment

After a double leverage cycle as outsized as we have just been through, it is likely that even with a lending facility established, and capital injected properly into the system, some, maybe many, firms would still fail. In general, that is what we should want. The government cannot afford to make good everybody’s debt. Some debtholders must lose when a financial system is allowed to become bloated by artificially high prices maintained by excess leverage from the ebullient stage of the leverage cycle. In the ebullient phase of this cycle, too many people were drawn into the financial sector by the resultant artificial profits. Failures will remove many of these excesses.

But what if those institutions are seen by the government as, in current jargon, systemically important? For those firms, the

Treasury might want to intervene, as the Fed did last year, on a case-by-case basis. But, if that approach is used, important issues are the degree to which the shareholders have to give up their shares and the bondholders lose their value, and whether new management should be put in place. Even in cases where old management is not that old, that is, cannot be reasonably charged with responsibility for all the excess, replacing management may be wise, if only to help bolster public support for the government’s actions and expenditures of taxpayer funds. It is also imperative that the government decide as quickly as possible after a crisis presents itself (and on grounds that can be explained as fair and objective), who it will let fail, and then coordinate an orderly liquidation. Quite possibly the biggest public relations risk the government runs in the bottom of the leverage cycle is to appear to be bailing out ailing firms on too generous terms.

If instead of injecting funds into an ailing firm the government takes it over, it must quickly decide what it will do with the creditors. Once it guarantees their debts, there is no turning back when the full extent of the firm’s asset value becomes clarified. In the case of AIG, it now appears that the government will lose much less money than was initially feared. But in the case of Fannie Mae and Freddie Mac, where the stakes are orders of magnitude bigger, we still do not know what the government losses will be. It is conceivable they may approach \$1 trillion, though that does not seem likely at the moment. This is another reason why steps one and two are urgently needed at the very outset of the crisis to clarify prices.

Government Purchases of Assets

The government could replace the lost optimistic capital by buying distressed securities directly. In effect, the Treasury would take conservative and pessimistic taxpayers’ money that would never be invested in these securities, and invest it there, assuming, of course, that it did so with the expertise necessary to make reasonably sound judgments on which securities to buy and how much to pay for them. This was the plan that Secretary Paulson originally proposed.

Government buying plans are a risky approach—riskier than the steps I have laid out above—and thus, if ever used, must be implemented with extreme care. An argument that is often blithely made for government buying is that when security prices are terribly depressed in “fire sales,” the government might make some good investments. It is likely, the argument goes, that the general taxpayer is too conservative, and by transforming pessimistic capital into optimistic capital, the government might even be directly helping the taxpayer, while at the same time staunching the collapse of security prices.

Forcing natural pessimists into purchases they fear, however much potential financial upside, may well undermine public confidence in government, especially if the investments start to go bad. But even if taxpayers were on board, caution should be the watchword. The lending mentioned earlier (a much more direct approach to restoring leverage) would probably raise security prices, so the government purchases would not be at rock-bottom prices. Private investors (naturally more agile and quicker than the government), knowing that the government would be buying, would rush to buy first, reducing potential government profits. Of course, that, in some sense, would be what the government would want to happen because it would mean that security prices would rise more quickly. But it might also result in taxpayers getting stuck with the worst assets, causing public outrage and charges of foul play.

The biggest obstacle and the one that apparently stopped Secretary Paulson's original plan to buy the troubled assets is the enormous challenge of deciding what to buy, and at what price. We must not forget that the downward swing in the leverage cycle is always triggered by genuine bad news, which I call scary because it creates more uncertainty. Private investors hold back for fear of "catching a falling knife"; the government has far less expertise than these private investors. Since the distressed mortgages are very heterogeneous, it is not at all clear how the government acting alone could figure out what prices to pay. Indeed, since Secretary Paulson's call for government purchases of distressed securities, a large number of them (including most CDOs) have continued to lose value, with some even going to zero. In retrospect, a program of indiscriminate buying might have been a disaster. But how could the government decide what to buy, and at what prices?⁵⁷

The dangers of government buying look so profound that in October 2008, I recommended that if the government were to buy at all, it would be better for the government to invest through professional money managers, again piggy-backing on the choices they make to invest their own capital.⁵⁸ To help ensure that money managers had the right incentives, I also recommended dividing the government money up among a large number of private managers and making the investments

⁵⁷ One suggestion that was made is by reverse auction. The government would divide the securities into different categories, and then buy from each category those securities that the current asset holders are willing to sell for the lowest price. But how would the government decide what the categories are and how much to spend on each? And how would it be protected from sellers' efforts to unload the worst securities in each category? If the purchases were to be made by an auction mechanism, I would have suggested a variation in which private bidders were allowed to enter the auction, not just private sellers. I would have recommended that the government commit to buying half the winners' purchases, at their winning prices. That way, the government could ride on the expertise of the private buyers. Still, even that solution could be gamed, particularly given that some private buyers might hold other positions—I am thinking of CDS here—that made it worthwhile for them to overbid in a manner that might not be easy to deter or discover.

⁵⁸ See Geanakoplos (2008).

and returns of these companies very public. These managers would then be competing with each other on a world stage to see how their investments performed. A more conventional incentive device would be to say that a manager gets no fees until the return on the assets passes some hurdle. Only after the taxpayers make money would the managers earn any fees.

The PPIP embodies a number of the same principles I advocated. Under the PPIP plan, the government has set up accounts with professional money managers in which each government equity dollar is invested side-by-side in the same securities with a dollar of investor capital. (This is in addition to the money loaned to the managers.)

Should another crisis arise, the government must be aware of the pitfalls of a large government buying program. The government cannot appear to the public as enriching the managers it entrusts with its money with fees that are too high. However, they must be given incentives to perform well. Otherwise, they might be tempted to spend taxpayer money buying portfolios sold by the failing companies of their cronies, in exchange for favors later on. Or they might pay less attention to the government investments than to the investments of their fee-paying clients. Or they might buy for the government with an eye toward benefiting their private clients by raising prices of assets the clients hold, or in some other way. These conflicts of interest become more acute to the extent that the number of managers is small and to the extent that they each have a huge amount of government money to wield. For example, a big enough buyer with government money could conceivably offer to rid a bank of toxic assets, at favorable prices, in exchange for favors like easier credit later on.

Another potential pitfall in government buying is the perverse incentives it might set up among sellers eager to get their securities purchased. For example, it may be that the banks were waiting for the government purchase not just of securities, but shaky whole loans too, and that hope may have contributed to their failure to modify whole loans in a rational manner.

Thus, even with all the advice I have offered about how the government should buy if it must, buying may still not be a wise policy, particularly not as a substitute for an adequate lending program, such as I described above.

6. MORAL HAZARD

It is often said that with every bailout comes a moral hazard that leads to a bigger problem the next time. The problem would be that bailing people out in this crisis would lead to higher leverage in the next cycle. There really is only one reliable antidote to that, and that is regulation of leverage.

One observation, which appeared in Geanakoplos and Kubler (2005), is that general systemwide interventions, like restoring sane leverage, in the crisis do not always create deleterious incentives in the long run. Surviving a crisis means tremendous profit opportunities in the good phase of the next cycle. If a systemic intervention gives prudent firms a chance to survive, rather than everyone going under, those firms will have an increased incentive to be prudent. Bailouts that rescue firms, no matter how imprudent they have been (in fact, precisely because they in particular were imprudent), are the source of moral hazard.

Some have suggested that writing down principal on mortgage loans will also cause moral hazard. They say it will encourage homeowners to behave badly, and the government to intervene in too many markets, and threaten the sanctity of contracts. I disagree, because the writing down of principal could be done as a function of the decline in some index of housing prices. The index is beyond the control of the homeowner, so it does not distort homeowner incentives. Moreover, it could be done first for homeowners who have not defaulted yet, and only later for homeowners who have defaulted under some special hardship. It could only be done, as I have said, if it promises to bring more money to the lenders. A good test of whether it is a good idea is whether it would be written into the contract in the first place if people had thought of the possibility of this much home price decline. I agree with Shiller (2008), who suggests that just these kinds of mortgages, with principal automatically reduced if some housing index falls enough, could and will likely become the standard mortgages of the future.

7. MANAGING THE EBULLIENT STAGE OF THE LEVERAGE CYCLE

After this crisis passes, we must prepare for the next leverage cycle. The first step is to constantly monitor leverage at the securities level, at the investor level, and at the CDS level.

Every newspaper prints the interest rates every day, but none of them mentions what margins are. The Federal Reserve needs to settle on a menu of different security classes, monitor their haircuts daily by talking to all the big lenders and borrowers, and then make averages public on a regular schedule, say every month or quarter.

The leverage of money managers could also be public. Moreover, legislation and regulations could contain strong and clear prohibitions against misleading the public or regulators on the degree of leverage.

I discussed at great length in Sections 3 and 4 how CDS contracts provide an opportunity to leverage, so these must be monitored as well. Putting them on an exchange would facilitate monitoring, as well as netting and ensuring enough collateral is posted. All too often CDS insurance buyers allowed the writers of insurance to get away without actually putting up the collateral. Repo lending too must be reorganized so that borrowers are protected in case the lenders go bankrupt and swallow up the borrower's collateral.

Transparency about actual leverage could bring a great deal of discipline to the market, and warn investors of impending trouble. In my earlier leverage charts, one can see the tremendous spikes in margins during the crisis stages of the last two cycles. One can also see a drift down in haircuts in the ebullient stage of the last cycle.

But transparency alone is not enough. Some investors will not curtail their leverage, no matter how much scrutiny by the public, and how far out of line with recent practice they become. Put bluntly, the market alone will not take care of outsized leverage. It is thus imperative that the Fed put outside limits on leverage. It will still be necessary to regulate leverage. The lesson of the leverage cycle is that there are many externalities (eight that I listed), and we should always expect cycles of too much leverage followed by too little leverage.

The most direct way to regulate leverage might be by empowering a "leverage supervisor" who could simply forbid loans at too high leverage in ebullient times, setting different leverage limits for different security classes. Banks would simply not be allowed to lend 97 percent of the value of the house, and repo lenders would not be allowed to reduce haircuts too far.

Many people have argued that setting margin limits is difficult because securities are so heterogeneous. But I believe this problem will eventually be solved once the haircut data history becomes more public. It was not obvious how to manage interest rates either. But little by little, the Fed has gotten better at it. The same will be true with leverage. The combination of security leverage data, investor leverage data, CDS leverage data, and asset price data could give the Fed tremendous information for managing future leverage cycles that it did not have, or chose to ignore, in this and in past leverage cycles. The critical thing is that with the data in hand, the Fed will be able to monitor dramatic changes in leverage and asset prices, and therefore will easily recognize when we are reaching either end of the cycle.

Another way of controlling leverage is to tax firms that borrow excessively, or that borrow excessively on their collateral, or that lend excessively on collateral. (The tax rate again would have to differ depending on the kind of

borrowing.) A very small tax might go a long way to discourage excessive leverage, and might also change the maturity structure, inducing longer term loans, if it were designed properly. Another advantage of the leverage tax is that revenues from it could be used to finance the lending facility the Fed would need to keep at the ready in anticipation of the downside of future leverage cycles.

Yet another way of controlling leverage is by mandating that lenders can only tighten their security margins very slowly. Knowing they cannot immediately adapt if conditions get more dangerous, lenders will be led to keep tighter margins in good, safe times.

Leverage constraints have been proposed at the investor level for selected financial firms. Congress is considering a hard cap on bank leverage of 15. There are six potential advantages, however, to limiting leverage at the securities level instead of at the investor level. The first is that many people can leverage; limiting leverage at banks or at a few other financial institutions might just induce leveraged purchases to move somewhere else. Second, the leverage of an investor is often a meaningless number, at least as an indicator of credit tightness, since just when things are getting bad, and margins on securities are tightening and the whole economy is being forced to deleverage, many firms will appear to be more leveraged because their equity will be disappearing. (It has become fashionable nowadays to say that leverage regulation should be countercyclical, by which people mean that investor leverage should be allowed to go up in bad times and down in good times. Enforcing a hard cap on investor leverage would paradoxically exacerbate the leverage cycle by forcing firms to sell at the bottom of the cycle, even if they had long-term loans that did not require rolling over.) Third, different securities include different amounts of “embedded leverage.” Thus, it makes sense to mandate different leverage numbers for

different securities. Setting an absolute leverage limit like 15, independent of the portfolio mix, might induce banks to shift their investments into securities with higher embedded leverage. Fourth, a focus on securities leverage would lead to derivatives such as CDS becoming part of the leverage numbers. As we saw, writing CDS insurance is like owning the underlying bond, so taking the ratio of the collateral required on the CDS to the cash price of the bond gives a good measure of the CDS leverage. Fifth, it is harder to hide securities leverage than investor leverage; for one thing, there is a counterparty to each security transaction reporting the same number that can be used by regulators as a check on reported numbers. Finally, a leverage supervisor managing securities leverage numbers might be less vulnerable to political pressure because his mandate would be more technical.

8. CONCLUSION

The leverage cycle brought us to the edge of a cliff. We have moved back from the precipice, but unless we understand the features of the leverage cycle and design our responses to address the specific problems that characterize the end stage of an outsized leverage cycle, we are left hoping for a miracle to restore our financial prosperity. Marking time and waiting for the miracle of things getting better appear to be part of the current government policy, at least as it relates to housing and foreclosures. That miracle, if it comes, will be nothing more than the start of another cycle, maybe one even worse than the one we have just experienced. My recommendations for solving the present crisis and managing the leverage cycle in its ebullient stage might prevent such an outcome.

REFERENCES

- Adrian, T., and H. Shin. Forthcoming. "Liquidity and Leverage." *JOURNAL OF FINANCIAL INTERMEDIATION*.
- Aragon, D., A. Caplin, S. Chopra, J. V. Leahy, Y. LeCun, M. Scoffier, and J. Tracy. 2010. "Reassessing FHA Risk." NBER Working Paper no. 15802, March.
- Backman, A., and G. O'Connor. 1995. "Rating Cash Flow Transactions Backed by Corporate Debt: 1995 Update." Moody's.
- Bernanke, B., M. Gertler, and S. Gilchrist. 1996. "The Financial Accelerator and the Flight to Quality." *REVIEW OF ECONOMICS AND STATISTICS* 78, no. 1 (February): 1-15.
- . 1999. "The Financial Accelerator in a Quantitative Business Cycle Framework." In J. B. Taylor and M. Woodford, eds., *HANDBOOK OF MACROECONOMICS*, vol. 1C, 1341-93. Elsevier.
- Brunnermeier, M. K., and L. H. Pedersen. 2009. "Market Liquidity and Funding Liquidity." *REVIEW OF FINANCIAL STUDIES* 22, no. 6 (June): 2201-38.
- Caballero, R. 2010. "The 'Other' Imbalance and the Financial Crisis." *VOX*, January 14.
- Caballero, R., E. Farhi, and P.-O. Gourinchas. 2008. "An Equilibrium Model of 'Global Imbalances' and Low Interest Rates." *AMERICAN ECONOMIC REVIEW* 98, no. 1 (March): 358-93.
- Caplin, A., S. Chan, C. Freeman, and J. Tracy. 1997. *HOUSING PARTNERSHIPS: A NEW APPROACH TO A MARKET AT A CROSSROADS*. Cambridge, Mass.: MIT Press.
- Caplin, A., C. Freeman, and J. Tracy. 1997. "Collateral Damage: Refinancing Constraints and Regional Recessions." *JOURNAL OF MONEY, CREDIT, AND BANKING* 29, no. 4, part 1 (November): 496-516.
- Dana, D. Forthcoming. "The Foreclosure Crisis and the Anti-Fragmentation Principle in State Property Law." *University of Chicago LAW REVIEW*.
- Farhi, E., and J. Tirole. 2009. "Collective Moral Hazard, Maturity Mismatch, and Systemic Bailouts." NBER Working Paper no. 15138, July.
- Ferreira, F., J. Gyourko, and J. Tracy. Forthcoming. "Housing Busts and Household Mobility." *JOURNAL OF URBAN ECONOMICS*.
- Foote, C. L., K. S. Gerardi, L. Goette, and P. S. Willen. 2009. "Reducing Foreclosures." Federal Reserve Bank of Boston *PUBLIC POLICY DISCUSSION PAPERS*, no. 09-02.
- Fostel, A., and J. Geanakoplos. 2008. "Leverage Cycles and the Anxious Economy." *AMERICAN ECONOMIC REVIEW* 98, no. 4 (September): 1211-44.
- Geanakoplos, J. 1997. "Promises, Promises." In W. B. Arthur, S. Durlauf, and D. Lane, eds., *THE ECONOMY AS AN EVOLVING COMPLEX SYSTEM*, vol. 2, 285-320. Reading, Mass.: Addison-Wesley.
- . 2003. "Liquidity, Default, and Crashes: Endogenous Contracts in General Equilibrium." In M. Dewatripont, L. P. Hansen, and S. J. Turnovsky, eds., *ADVANCES IN ECONOMICS AND ECONOMETRICS: THEORY AND APPLICATIONS*, vol. 2, 170-205. *Econometric Society Monographs: Eighth World Congress*. Cambridge University Press.
- . 2008. "Solving the Present Crisis and Managing the Leverage Cycle." Remarks delivered at the Board of Governors of the Federal Reserve System, Washington, D.C., October 3.
- . 2010. "The Leverage Cycle." In D. Acemoglu, K. Rogoff, and M. Woodford, eds., *NBER MACROECONOMICS ANNUAL 2009*, vol. 24, 1-65. Chicago: University of Chicago Press.
- Geanakoplos, J., and S. Koniak. 2008. "Mortgage Justice Is Blind." Editorial. *NEW YORK TIMES*, October 30.
- . 2009. "Principal Matters." Editorial. *NEW YORK TIMES*, March 5.
- Geanakoplos, J., and F. Kubler. 2005. "Leverage, Incomplete Markets, and Pareto Improving Regulation." Unpublished paper.
- Geanakoplos, J., and H. Polemarchakis. 1986. "Existence, Regularity, and Constrained Suboptimality of Competitive Allocations when the Asset Market Is Incomplete." In W. P. Heller, R. M. Starr, and D. A. Starrett, eds., *SOCIAL CHOICE AND PUBLIC DECISION MAKING: ESSAYS IN HONOR OF KENNETH J. ARROW*, 65-96. Cambridge University Press.

REFERENCES (CONTINUED)

- Geanakoplos, J., and W. Zame.* 2009. "Collateralized Security Markets." Unpublished paper.
- Gromb, D., and D. Vayanos.* 2002. "Equilibrium and Welfare in Markets with Financially Constrained Arbitrageurs." *JOURNAL OF FINANCIAL ECONOMICS* 66, nos. 2-3 (November-December): 361-407.
- Gyourko, J., and A. Saiz.* 2004. "Reinvestment in the Housing Stock: The Role of Construction Costs and the Supply Side." *JOURNAL OF URBAN ECONOMICS* 55, no. 2 (March): 238-56.
- Haughwout, A., E. Okah, and J. Tracy.* 2009. "Second Chances: Subprime Mortgage Modification and Re-Default." Federal Reserve Bank of New York *STAFF REPORTS*, no. 417, December.
- Haughwout, A., R. Peach, and J. Tracy.* 2008. "Juvenile Delinquent Mortgages: Bad Credit or Bad Economy?" *JOURNAL OF URBAN ECONOMICS* 64, no. 2 (September): 246-57.
- Holmstrom, B., and J. Tirole.* 1997. "Financial Intermediation, Loanable Funds, and the Real Sector." *QUARTERLY JOURNAL OF ECONOMICS* 112, no. 3 (August): 663-91.
- Kiyotaki, N., and J. Moore.* 1997. "Credit Cycles." *JOURNAL OF POLITICAL ECONOMY* 105, no. 2 (April): 211-48.
- Minsky, H. P.* 1986. *STABILIZING AN UNSTABLE ECONOMY.* New Haven, Conn.: Yale University Press.
- Myers, S. C.* 1977. "Determinants of Corporate Borrowing." *JOURNAL OF FINANCIAL ECONOMICS* 5, no. 2 (November): 147-75.
- Peristiani, S., P. Bennett, G. Monsen, R. Peach, and J. Raiff.* 1997. "Effects of Household Creditworthiness on Mortgage Refinancing." *JOURNAL OF FIXED INCOME* 7, no. 3 (December): 7-21.
- Shiller, R.* 2008. *THE SUBPRIME SOLUTION: HOW TODAY'S GLOBAL FINANCIAL CRISIS HAPPENED AND WHAT TO DO ABOUT IT.* Princeton, N.J.: Princeton University Press.
- Tobin, J., and S. S. Golub.* 1998. *MONEY, CREDIT, AND CAPITAL.* New York: McGraw-Hill/Irwin.