The Leverage Cycle

John Geanakoplos
This crisis has been a typical leverage cycle

- Too much leverage caused boom, as it has many others
- Leverage should be regulated; so far nothing much done about it.
- Too little leverage helped cause crash. No permanent facility put in place for that.
- In crisis must inject equity; instead got forbearance. Banks denied losses.
- Only way to end the aftermath is typically to force lenders to forgive debt. This also hasn’t happened.
Fed Should Manage Leverage as well as Interest Rates

• From Irving Fisher in 1890s and before it has been commonly supposed that the interest rate is the most important variable in the economy.

• When economy slows, public clamors for lower rates, and Fed obliges.

• Fed has been pumping out billions of dollars in bank loans. Fed lowered fed funds rate in December 2008 to zero.

• But collateral rates or leverage more important in times of crisis.
What’s Wrong with Macroeconomic Models

• Didn’t predict crisis. Didn’t predict effect of stimulus.
• All based on technology shocks or shocks to expectations of technology.
• Even fitting those models after the fact to the crisis, no connecting shocks in model to actual shocks.
• No changes in leverage in those models as a result of changes in perception of default.
• Faulty understanding of debtor-creditor relationship
The Merchant of Venice

Shakespeare got this Right 400 years ago.

Who can remember the interest rate Shylock charged Antonio and Bassanio?

Bassanio is no fool.

Quality of Mercy
Leverage Cycle Papers

- Geanakoplos 1997 “Promises Promises”
- Fostel-Geanakoplos 2008 “Leverage Cycles and the Anxious Economy”. AER.
- Geanakoplos 2009 Macro Annual “The Leverage Cycle”
- Geanakoplos 2010 “Managing the Leverage Cycle” NYFed Economic Policy Review
- Thurner, Farmer, Geanakoplos 2010 “Leverage Causes Fat Tails and Clustered Volatility”
- Fostel-Geanakoplos 2010 “Why does Bad News Increase Volatility and Decrease Leverage”
- Fostel-Geanakoplos 2011 “Beyond Var = 0”
- Fostel-Geanakoplos 2011 “Securitization, Derivatives, and Asset Pricing”
Early Collateral Papers

• Bernanke-Gertler-Gilchrist 1996, 1999
• Kiyotaki-Moore 1997

• But these papers ignored changes in leverage. Really about credit cycles, not leverage cycles. In Kiyotaki-Moore leverage rises after bad news, dampening the crisis.
Recent Leverage Papers

- Brunnermeier-Pedersen (2009)
- Adrian-Shin (2009)
- Simsek (2010)
- Cao (2010)
- Krishnamurthy (2010)
- Acharya (2010)
I. Leverage and Asset Pricing
Definition of Securities Leverage

• **Collateral** = Asset put up as guarantee of loan. Often a house. I will assume no-recourse loans, like housing.

• If can use $100 house to borrow $80, then margin or **down-payment** or **haircut** is 20%.

• **LTV** is 80%, leverage is 5.

• Leverage on **new** loans is different from debt/equity on old loans. Reinhart-Rogoff talk about leverage going up for 2 years after big crisis, then de-leverage for 5-7 years. Using debt/equity. Important too.
Equilibrium Leverage

Standard Economic Theory:

Equilibrium (supply = demand) determines interest rate.

In my theory:

Equilibrium determines Leverage as well.

Surprising that one equation can determine two variables.

In standard theory either ignore default (hence need for Collateral) or fix leverage at some constant.
What Determines Leverage

- **Interest rates** determined by impatience.
- **Leverage** determined by uncertainty about and disagreement over future collateral prices. *Volatility* is crucial.
  - In long run financial innovation increases leverage, e.g. by creating tranching and pyramiding
Why Leverage is important

• As every trader knows, if leverage is 5, and asset moves by 1%, your return moves by 5%. If house price is $101, sell it, return $80 and make $1 on $20 = 5%.

• No-recourse collateral gives borrower the “put option” to walk away from the house. House falls in value to $0, borrower walks away and loses only $20 even though lender loses $80.

• Pundits say these two effects of leverage had big effect on crisis. If banks hadn’t been so leveraged, they wouldn’t have lost so much money and we wouldn’t have had bailout. My theory also includes these two effects.

• But real significance of leverage in my theory is that it allows just a few investors to buy so many assets, and so explains bubbles.
More Leverage $\rightarrow$ Higher Asset Prices

Low Leverage $\rightarrow$ Lower Asset Prices

- Leverage gives optimists more buying power.
- Relies on no short sales.
Marginal Buyer Theory of Price

Natural buyers = Optimists
Marginal buyer

Public = Pessimists

If no short selling. That’s why CDS became important.
II. Leverage Cycle in Theory

- Long period of Low Volatility
- Leverage goes up because of low vol and gradual innovation
- Optimists acquire more and more of assets
- Asset prices go up
- Sets stage for crash
Leverage Cycle Crashes Always Have same three aspects

• **Bad news** makes everyone value assets less. But bad news is also **scary**, creating more uncertainty and more disagreement = high volatility

• **De-leveraging** because nervous lenders ask for more collateral

• **Leveraged buyers** (optimists) crushed, some go **bankrupt**, others insolvent and functioning poorly.
Highs and Lows

• Leverage makes the asset price higher than it would have ever been without leverage.
• But the low is lower than it would have been without leverage.
• The gap between high and low is thus much bigger than it would have been.
• Thus the number of underwater businesses and homeowners can be huge.
III. Recurring Leverage Cycles

- Tulip bulb craze in 1637 in Holland.
- Land boom and crash in 1920s in Florida before Depression.
- 1998 emerging markets and mortgages, bankrupted Long Term Capital
- 2007-9 subprime mortgage crash
The current leverage cycle
Observe that the Down Payment axis has been reversed, because lower down payment requirements are correlated with higher home prices.

Note: For every AltA or Subprime first loan originated from Q1 2000 to Q1 2008, 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 of the list is shown in the diagram. This number is an indicator of down payment required: clearly many homeowners put down more than they had to, and that is why the top half is dropped from the average. A 13% down payment in Q1 2000 corresponds to leverage of about 7.7, and 2.7% down payment in Q2 2006 corresponds to leverage of about 37.

Note Subprime/AltA Issuance Stopped in Q1 2008.
Securities Leverage Cycle
Margins Offered and AAA Securities Prices

Average Margin on a Portfolio of CMOs Rated AAA at Issuance
- Estimated Average Margin
Prime Fixed Prices

Note: The chart represents the average margin required by dealers on a hypothetical portfolio of bonds subject to certain adjustments noted below. Observe that the Margin % axis has been reversed, since 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 Aug. 2008, a substantial part of the increase in margins is due to bonds that could no longer be used as collateral after being downgraded, or for other reasons, and hence count as 100% margin.
Leverage dramatically increased from 1999-2006

• A bank that wanted to buy a AAA mortgage security could borrow 98.4% of purchase price, paying down only 1.6% cash. That’s over 60 to 1 leverage.

• Average leverage in 2006 across all $2.5 trillion of toxic mortgage securities was 16 to 1.

• So buyers only had to pay $150 billion cash, and borrow $2.35 trillion! Warren Buffet and Bill Gates alone could have bought all toxic mortgage securities in 2006.

• Home buyers could get mortgage with 3% down in 2006, for leverage 33 to 1.
Then leverage drastically curtailed by nervous lenders wanting more collateral

- Toxic mortgage securities leverage fell to average less than 1.2 to 1.

- Homes leveraged only 3 to 1 unless get government guaranteed loan
How did crash start?

• Conventional view is that housing prices suddenly fell, and fell more than anyone imagined, so banks lost huge money, and that rippled through economy.
• My view: Housing prices had been going up because of increasing leverage, but LTV can’t go above 100, so increase bound to stop as LTV approached 100.
• Scary bad news of delinquencies + credit default swaps creation in mortgages at top of cycle led to dramatic fall in BBB prices before big fall in housing prices.
• Led to tightening of collateral on houses. That led to dramatic fall in housing prices. Then government did not intervene properly in housing market, and prices fell further.
Observe that the Down Payment axis has been reversed, because lower down payment requirements are correlated with higher home prices.

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Housing Peak at Q2 2006
Slightly down Q4 2006
CDS created on subprime late 2005
ABX securities index collapses Jan 2007
Then housing prices start to free fall
BBB prices crash before big drop in housing
Scary
Bad News

DQ / Orig

OTS Delinquent 90+ / Orig

CWL 2003-1
CWL 2004-1
CWL 2005-1
CWL 2006-1
CWL 2007-1
IV. 2007-9 Worst Leverage Cycle because

- Leverage got higher than ever before.
  - Prolonged low volatility
  - Securitization innovation
  - Government implicit guarantees e.g. to Fannie and Freddie and to Too Big to Fail banks allows them all to borrow more cheaply, and therefore to leverage more.
  - Banks lied about how leveraged they were.
  - Low rates (global imbalances) encouraged search for yield via leverage.
- Houses and banks further underwater making for bigger foreclosure deadweight costs
- Double leverage cycle, in housing and securities.
  - Feedback between the two
- CDS appeared for first time at peak of cycle
  - Allowed pessimists to leverage and helped cause crash.
  - Since optimists selling insurance instead of buying it, CDS added to losses for optimists when asset prices fell
We propose the possibility that the mortgage boom and bust crisis of 2007-2009 might have been greatly exacerbated by financial innovation.

**Timing** of financial innovation:

Leverage and Securitization came first, raising asset prices, then

CDS followed much later, crushing their prices.
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Tranching

• A more sophisticated kind of leverage, with even greater effect on price.
Leverage Cycle and CDS

- CDS market not standardized for mortgages until 2005.
- CDS allow pessimists to leverage their opinion that market is too high instead of sitting on sidelines.
- That was another shock at top of bubble.
- Market might never have gotten so high if CDS traded from beginning.
Big growth, but after Growth in securitization

Source: IBS OTC Derivatives Market Statistics
Unexpected Introduction of Tranching at $t=2$

Unexpected Introduction of CDS at $t=3$

Unexpected introduction of Leverage at $t=1$
What’s so bad about so much leverage? (1) Debt and Default

• What if optimists indispensable to economy: too big to fail. Bankruptcy externality.

• Debt overhang: When underwater will not choose PV > 0 projects because old investors get the money

• Cost of confiscation of collateral – homes today fetch ¼ of subprime loan amount when sold, after vandalism etc.
What’s so bad about leverage?

(2) Volatile Prices affect output and wealth

- Prices have real effects on economic activity. Tobin Q.
- At top so few buyers have such a big effect on prices. What if they are crazy? Construct many projects which look ridiculous in retrospect when cycle turns down. Costly if irreversible investment. Too much investment.
- At bottom people cannot sell new loan at $100 to buy car when a comparable old auto loan sells at $65. Too little investment.
- Unfair to subject risk averse public to so much volatility in income.
- Fortunes of natural buyers rise and fall through cycle. Changing inequality over cycle.
What to Do About Leverage Cycle?

• Collect leverage data and make it public.
• Put CDS on exchange.
• Regulate security and investor leverage when normal

• In the crisis, reverse the three symptoms:
  – Reduce uncertainty. Clarify who is bankrupt and who not.
  – Releverage the system by going around banks to lend with less collateral
  – Inject equity to replace natural buyers.

• In aftermath work to reduce debt overhang.
  – Stop foreclosures in order to avoid deadweight losses, and to stabilize uncertainty and margins: write down principal.
Govt failed to address heart of aftermath problem

• Crisis began in January 2007 in subprime mortgages more than four years ago.
• Nothing substantial has been done to deal with massive foreclosure problem.
• Haven’t begun to confront problem of debt overhang for homeowners, businesses, banks, and government.
Foreclosure Disaster

- 2.5 million homes already lost to foreclosure
- Another 5 million seriously delinquent loans outstanding, almost all will be lost
- Of the 50 mm outstanding loans that are current:
  - 8.5 million underwater
    - 5.6 million Prime
    - 2.1 million Alt-A
    - 800 thousand Subprime
  - These loans are at high risk of defaulting as long as they remain underwater
Foreclosure Policy Mistakes

• Thought that temporarily writing down interest would make a big difference
• Thought could give small incentives to Servicers and Banks and they would make modifications
Warned 2.5 Years Ago


• NY Times Op-ed March 2009 “Principal Matters” advocated writing down principal as only solution.
Community Bankers

• Government could hire community bankers in each area.
• Loan information would be sent to them.
• Their job would be to modify loans to make as much money as possible for lender.
Write Down Principal

• Crisis stage of leverage cycle always involves lots of firms and people underwater. This causes tremendous uncertainty, exacerbating crisis.
• Usually necessary to resolve these problems quickly by taking losses right away and writing down principal.
• Failure to do so loses for everyone.
• Underwater won’t fix house, can’t borrow to do it even if wanted to.
Foreclosures

• Homeowners defaulting primarily because they are underwater. Reducing their interest rates temporarily will not solve any problems, but make them worse.
Net Monthly Flow (Excluding Mods) from <60 days to >=60 days DQ
6 Month Average as of Jan 09

CCLTV < 60
CCLTV 60-80
CCLTV 80-90
CCLTV 90-100
CCLTV 100-110
CCLTV 110-120
CCLTV 120-140
CCLTV 140-160
CCLTV > 160

06-2 Indices
- ABX (Subprime)
- Option ARM
- Alt-A ARM
- Alt-A Fixed
- Prime ARM
- Prime Fixed
Principal should be written down

- Losses from foreclosure are horrible. Get on average 25% back on loan from foreclosing a subprime loan.
- Takes 18 months to 3 years nowadays to throw somebody out of his house.
- Mortgage not paid, taxes not paid, house not fixed, house often vandalized, realtor expenses etc.
- If write down principal on subprime loans, get more for lender and borrower!
Why servicers won’t write down principal

- Expensive to hire staff to figure out how far to write it down
- Fee would be cut by same proportion
- Homeowner might then sell house and then servicer loses whole fee.
- Servicers owned by big banks which own huge number of second loans – if cut first loan principal, second loan should be cut to zero.
Why big banks cut principal but not enough

• They don’t have to mark loans to market
• They don’t want to take write downs now, even if it will cost more money down the road.
Modifications so Far

- 600k modifications made permanent under HAMP
- Servicers have modified an additional 1.1 million loans under non-HAMP programs.
- Tiny number modified
- Wrong modifications
- Most simply redefault
Subprime Recidivism by Coupon and Months Since Mod

Monthly Redefault Rate

Months Since Mod

- 2%
- 3%
- 4%
- 5%
- 6%
Subprime Cumulative Recidivism by Coupon and Months Since Mod

Months Since Mod

Cumulative Recidivism

- 2%
- 3%
- 4%
- 5%
- 6%
Default, Punishment, Forgiveness

• Idea that defaulting is morally reprehensible.
• Or that forgiving loans would create moral hazard and encourage future default.
• And prevent lenders from lending.
• All wrong. See Dubey-Geanakoplos-Shubik.
• Default on Sovereign bonds and pensions coming down the road.
END
### Percentages of Each Type of Modification by Investor in Third Quarter 2010

<table>
<thead>
<tr>
<th></th>
<th>Fannie Mae</th>
<th>Freddie Mac</th>
<th>Government-Guaranteed</th>
<th>Private Investor</th>
<th>Portfolio</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capitalization</td>
<td>98.3%</td>
<td>98.2%</td>
<td>99.6%</td>
<td>78.8%</td>
<td>58.8%</td>
<td>87.5%</td>
</tr>
<tr>
<td>Rate Reduction</td>
<td>91.1%</td>
<td>78.7%</td>
<td>97.1%</td>
<td>87.5%</td>
<td>70.8%</td>
<td>86.2%</td>
</tr>
<tr>
<td>Rate Freeze</td>
<td>2.2%</td>
<td>2.9%</td>
<td>0.4%</td>
<td>2.0%</td>
<td>2.0%</td>
<td>1.9%</td>
</tr>
<tr>
<td>Term Extension</td>
<td>51.0%</td>
<td>67.4%</td>
<td>81.0%</td>
<td>38.8%</td>
<td>59.6%</td>
<td>57.4%</td>
</tr>
<tr>
<td><strong>Principal Reduction</strong></td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.2%</td>
<td>25.1%</td>
<td>4.5%</td>
</tr>
<tr>
<td>Principal Deferral</td>
<td>11.7%</td>
<td>12.6%</td>
<td>0.1%</td>
<td>11.5%</td>
<td>13.8%</td>
<td>10.1%</td>
</tr>
<tr>
<td>Unknown</td>
<td>0.2%</td>
<td>0.3%</td>
<td>0.2%</td>
<td>1.2%</td>
<td>9.1%</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

### Re-Default Rates for Portfolio Loans and Loans Serviced for Others

(60 or More Days Delinquent)*

<table>
<thead>
<tr>
<th>Investor Loan Type</th>
<th>Three Months After Modification</th>
<th>Six Months After Modification</th>
<th>Nine Months After Modification</th>
<th>12 Months After Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fannie Mae</td>
<td>15.2%</td>
<td>27.6%</td>
<td>42.5%</td>
<td>52.5%</td>
</tr>
<tr>
<td>Freddie Mac</td>
<td>16.2%</td>
<td>28.7%</td>
<td>44.2%</td>
<td>55.8%</td>
</tr>
<tr>
<td>Government-Guaranteed</td>
<td>21.6%</td>
<td>42.9%</td>
<td>55.9%</td>
<td>62.3%</td>
</tr>
<tr>
<td>Private</td>
<td>28.1%</td>
<td>42.1%</td>
<td>52.5%</td>
<td>58.2%</td>
</tr>
<tr>
<td>Portfolio Loans</td>
<td>9.2%</td>
<td>18.2%</td>
<td>24.8%</td>
<td>30.1%</td>
</tr>
<tr>
<td>Total</td>
<td>20.0%</td>
<td>33.8%</td>
<td>44.7%</td>
<td>51.4%</td>
</tr>
</tbody>
</table>

Source: OCC and OTS Mortgage Metrics Report – Fourth Quarter 2010
• Of loans in ABX 07-2 (subprime loans made in the 1st half of 2007, shortly before the subprime market shutdown):
  – 10% have paid off voluntarily
  – 60% have either been liquidated or are delinquent
  – 30% remain outstanding and are current
    • 10% have been delinquent at some point, but are current today due to modification
    • 20% have always been current
Will Dodd-Frank help?

- Established Financial Stability Oversight Council (FSOC), chaired by Secretary of Treasury, with Chairman of Fed, and chairs of other large regulatory bodies.
- Giving responsibility is helpful.
- Similar to Reagan’s President’s Advisers Council.
- Difference of Office of Financial Research, who must gather data and report directly to Congress each year on systemic risks.
Why hasn’t Obama administration solved the present crisis?
Worried about the Banks

• Their thinking is that the crisis threatened to bring down the whole banking sector.
• God help America if that happened.
• So every policy designed to pump money into banks and to convince public they are sound.
• Keep everything afloat. Do no harm.
• Sit back and wait for a miracle.
Banks

• Lowering short rates enriches banks.
• Reducing interest on subprime loans (instead of cutting principal) enriches banks.
Why Fed and Obama team underestimated size of recession

• They predicted unemployment would top out at 8%. They still claim they saved millions of jobs.

• They figured lowering the interest rates and a small stimulus would pull the economy out of its slump.

• They have nothing in their models to calibrate credit frictions like increased collateral requirements, or people under water.
Need inflation

• Reduce government debt.
• Bring homeowners out from underwater.
• It is inevitable.
Need stimulus

• Put 20% of construction workers now unemployed into building infrastructure.
• Good infrastructure makes money for country in long run, even if done at full employment.
• Makes much more sense with unemployment.
• People say debt got us into trouble, can’t have more.
• Argument backward. Project could lower net liability of country. People still willing to lend to US.