

The financial crisis

S. Hsu

ITS, November 2008

The problem of valuation

Market value: what someone will pay you, **right now**, for a security (stock, bond, real estate, ...)

Fundamental value: sum of future payment streams generated by the security.

Is this knowable? **RISK** ; metrics for valuation

nearly risk free: Treasuries, savings accounts, **houses?**

risky: stocks, junk bonds

High risk → investors require high return “**risk premium**”

Markets and information

Markets aggregate and process **information**. The NYC bagel problem. Price signals. How else to organize complex activities? Central planning fails.

EMH: Efficient Market Hypothesis (many flavors)

weak: markets price securities better, on average, than any individual could ◇

strong: markets, on average, allocate societal resources in the maximally efficient manner

(Or at least better than any central authority could?)

◇ random walks, stochastic processes, indexing, etc.

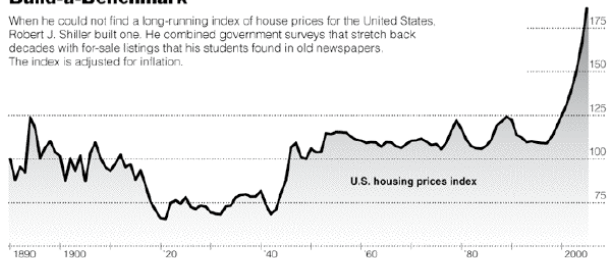
Bubbles

Irrationality, behavioral economics. Aggregations of apes are not necessarily more rational than the apes themselves.

Individual judgements on valuation depend on future extrapolations, psychology, “animal spirits”, sociology, etc.

Build-a-Benchmark

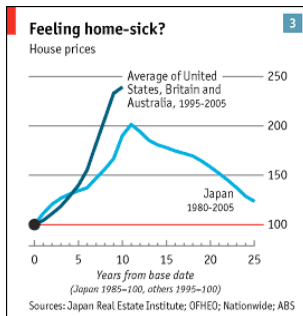
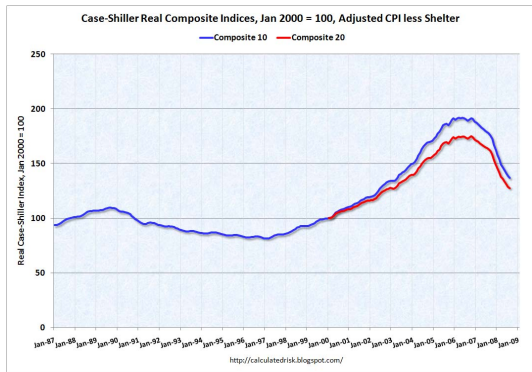
When he could not find a long-running index of house prices for the United States, Robert J. Shiller built one. He combined government surveys that stretch back decades with for-sale listings that his students found in old newspapers. The index is adjusted for inflation.



Source: "Irrational Exuberance," Robert J. Shiller

Bubbles

US housing stock = \$20 trillion ; total US investments \$50 trillion.



Bubbles

We've seen it all before... a vast misallocation of resources.



Fragility and Systemic risk

Total mortgage losses (net of default recovery, etc.) of order one trillion dollars. How could this loss destroy our \$ 50 trillion financial system?

Answers:

1) **leverage**

2) **complexity**

Interlude for physicists

The economy is a complex dynamical system.

It is nonlinear.

Cellular automata with *memory* \rightarrow *path dependence* ; history matters! institutions matter!

Each automaton has limited access to information, and limited information processing ability: *bounded rationality*.

Securitization

Central Limit Theorem ; Law of Large Numbers: independent (uncorrelated) fluctuations cancel out when aggregated.

Flip a coin N times; ratio of heads to tails approaches half with certainty as N gets large.

Applications to insurance, banking, **mortgage securitization**
Independence assumption is crucial!



Securitization

Insurance: how many car accidents per day?

Mortgages: what fraction of people in Portland with credit score x , LTV ratio y , ... will default this year? Will my neighbor default this year?

CDO: Collateralized Debt Obligation. A bundle of mortgages. Are mortgage defaults uncorrelated? Do we know the probabilities?

Securitization

Want to model the default risk of a new *class* of (subprime) mortgage. Must use historical data.

Only historical data available is recent – bubble data. Increasing prices of homes masks buyers' inability to make payments.

But many experts didn't believe in a widespread bubble (e.g., Krugman NYTimes op-ed 2006), so perhaps recent data were ok?

Also, even depression era default rates (peak 15% in 1933) were not as high as realized in some subprime categories.

Finally, in a nationwide bubble collapse, default *correlations* explode – securitization fails!

Leverage

How much money is there in the economy right now? (“money supply”)

Surprisingly subtle question.

Strongly affected by borrowing or leverage. Consumers can buy things today, and promise to pay in the future (mortgages, credit cards). Banks can lend out many times their capital base to borrowers. Investors can borrow and buy securities on margin. Companies, municipalities, states, and the US government can issue bonds to raise cash, promising to pay interest.

Interest rates \longleftrightarrow risk premia

Controlled by Fed? Controlled by bond markets? Controlled by ape sentiment? Record low interest rates in wake of 2001 tech bubble collapse.

Mortgage finance

buyer → mortgage broker → CDO issuer → CDO buyer

CDO issuer = banks, Fannie, Freddie

CDO buyer = banks, hedge funds, pension funds, sovereign wealth funds

Ratings agencies: Standard and Poors, Moody's. AAA ratings given to CDOs of subprime mortgages.

Were people stupid? Or were incentives wrong at each level?

Mortgage finance: incentives

Borrower: ...I wouldn't have loaned me the money. And nobody that I know would have loaned me the money. I know guys who are criminals who wouldn't loan me that and they break your knee-caps. I don't know why the bank did it.

...Nobody came and told me a lie: just close your eyes and the problem will go away. That's wasn't the situation. I needed the money. I'm not trying to absolve myself of anything. I thought I could do this and get out of it within 6 to 9 months. The 6 to 9 month plan didn't work so I'm stuck.

Quotes from This American Life radio show 355, spring 2008.

Mortgage finance: incentives

Mortgage broker ...it was unbelievable. We almost couldn't produce enough to keep the appetite of the investors happy. More people wanted bonds than we could actually produce. That was our difficult task, was trying to produce enough. They would call and ask "Do you have any more fixed rate? What have you got?"

...my boss was in the business for 25 years. He hated those loans. He hated them and used to rant and say, "It makes me sick to my stomach the kind of loans that we do." He fought the owners and sales force tooth and neck about these guidelines. He got same answer. Nope, other people are offering it. We're going to offer them too. ...House prices are booming, everything's gonna be good. ...

Mortgage finance: incentives

Wall St. banker ...No income no asset loans. That's a liar's loan. We are telling you to lie to us. We're hoping you don't lie. Tell us what you make, tell us what you have in the bank, but we won't verify? We're setting you up to lie. Something about that feels very wrong. It felt wrong way back when and I wish we had never done it. Unfortunately, what happened ... we did it because everyone else was doing it.

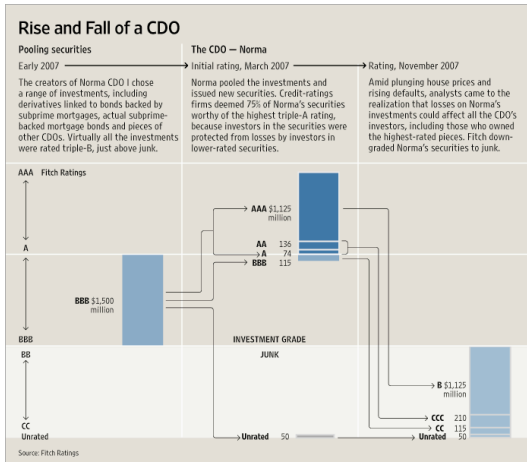
...All the data that we had to review, to look at, on loans in production that were years old, was positive. They performed very well. All those factors, when you look at the pieces and parts. A 90% NINA loan from 3 years ago is performing amazingly well. Has a little bit of risk. Instead of defaulting 1.5% of the time it defaults at 3.5% of the time. That's not so bad. If I'm an investor buying that, if I get a little bit of return, I'm fine.

Mortgage finance: incentives

CDO packager: ... In 2005, we had an internal debate here because there were two banks coming to us, why don't you do a deal with us, BBB securities, you get paid a million bucks in management fees per year. Very clear, just like that, in 2005. And we declined those deals. We just don't believe those BBB RMBS assets are money-good. And we thought if we do a CDO of those, that's gonna blow up completely. We were early in '05 by not wanting to do those deals. People were laughing at us. Saying you're crazy. You're hurting your business. Why don't you want to make ... Per deal, you could make a million dollars a year.

Mortgage finance

Trillions of dollars in bad mortgages – but who is holding them?



Mortgage finance: BBB to AAA

Suppose BBB loans have a large probability of default: e.g., $p = .1 = 1/10$.

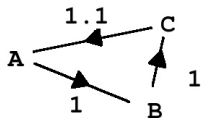
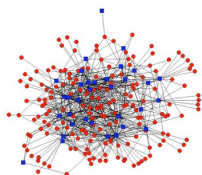
Aggregation of many BBB loans will still have an expected loss rate of .1, but the **uncertainty** in this loss rate can be made small by central limit theorem.

CDO repackager can create AAA tranches by artificially separating the first chunk of losses from the rest – i.e., pay someone to take the expected loss (p times the total value of the loan pool) plus some additional cushion.

Holders of the remaining AAA tranches are only responsible for losses beyond this first chunk. **The potential for catastrophe is clear!**

CDS web

CDS = Credit Default Swap. \$60 trillion in bets on credit defaults.



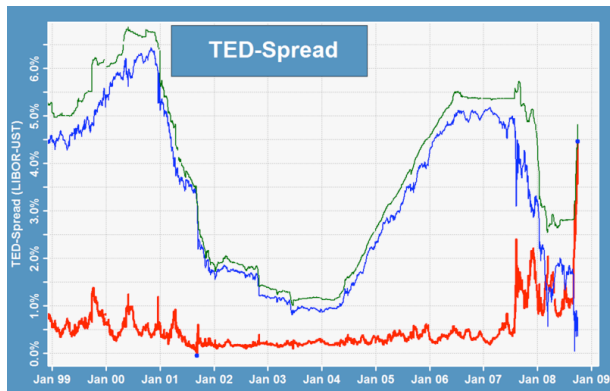
Notional value of bets \gg Net value, unless one of the nodes disappears!

Lehman's collapse triggered the meltdown. Now a bankruptcy court is sorting through 1.5 M derivatives trades with over 8000 counterparties.

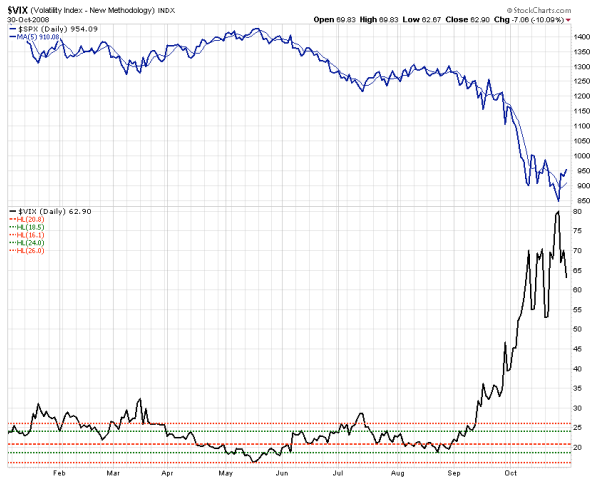
Crisis

Where are the bad loans? Who is insolvent?

TED spread: Measure of fear or risk premia: London Interbank Rate (LIBOR) versus US Treasury rate (3 month)



SP 500 and volatility index.



Crisis

Bankrupt or nationalized entities:

Fannie Mae, Freddie Mac, Lehman Brothers, Bear Stearns,
Washington Mutual, AIG, ...

10 million Americans are “upside down” on their mortgages.

\$800B in Treasury bailout funds

+\$1.5 Trillion on Fed balance sheet

Crisis: the fall of AIG

AIG: primarily an insurance company; 100k employees in 130 countries, \$1 trillion balance sheet.

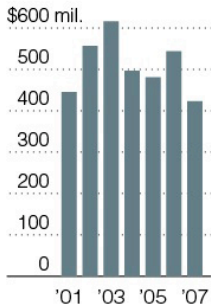
Destroyed by 377 person unit in London that traded CDS contracts (insurance on CDOs). Unit headed by J. Cassano, who earned over \$100 million in compensation during the bubble. Employees in the unit averaged over \$1 million per year in compensation since 2001.

“It is hard for us, without being flippant, to even see a scenario within any kind of realm of reason that would see us losing one dollar in any of those transactions.” – Joseph J. Cassano, a former A.I.G. executive, August 2007

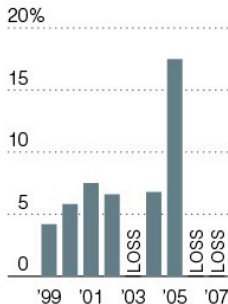
AIG was rescued by the US Treasury and has taken over \$100B in emergency financing. They had sold over \$400B in CDS.

Crisis: the fall of AIG

A.I.G.F.P. EMPLOYEE COMPENSATION



SHARE OF ALL A.I.G. OPERATING INCOME FROM A.I.G.F.P.



\$294 billion
Value of corporate debt insured by A.I.G.F.P. against default

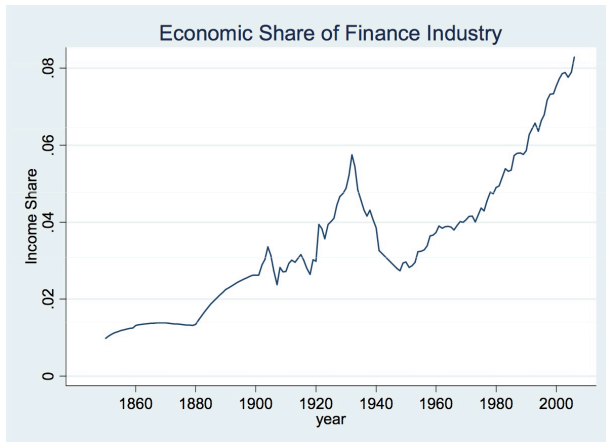
\$141 billion
European residential mortgages

\$78 bil.
C.D.O.'s, including some subprime

A.I.G.F.P. insured \$513 billion of debt against default using

The future

More regulation. More government intervention in markets.
The end of the finance boom itself?



The future

GEORGE SOROS: ...this belief that everybody pursuing his self-interests will maximize the common interests or will take care of the common interests is a false idea. It's a suitable idea for those who are rich, who are successful, who are powerful. It suits them to justify enjoying the fruits without paying taxes.

The future

ALAN GREENSPAN: I made a mistake in presuming that the self-interests of organizations, specifically banks and others, were such as that they were best capable of protecting their own shareholders and their equity in the firms.

CHAIRMAN WAXMAN: In other words, you found that your view of the world, your ideology, was not right, it was not working.

ALAN GREENSPAN: Absolutely, precisely. You know, that's precisely the reason I was shocked, because I have been going for 40 years or more with very considerable evidence that it was working exceptionally well.