The Leverage Cycle and Forgiveness

John Geanakoplos
Yale University
Ellington Capital Management
Santa Fe Institute

1

The American crisis of 2007-09 has been a typical leverage cycle

- Too much leverage caused boom, as it has many others

- Too little leverage helped cause crash.

- Typically only way to end the aftermath is to force lenders to forgive debt. This hasn't happened.

- Leverage should be regulated; so far nothing much done about it.

- No permanent facility put in place to increase leverage in a crisis.

- In beginning of crisis must force banks to raise equity; instead got forbearance.

- Greece not so different

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.

- Shocks in model do not increase uncertainty.

- No changes in leverage in those models as a result of changes in perception of default.

- Faulty understanding of debtor-creditor relationship
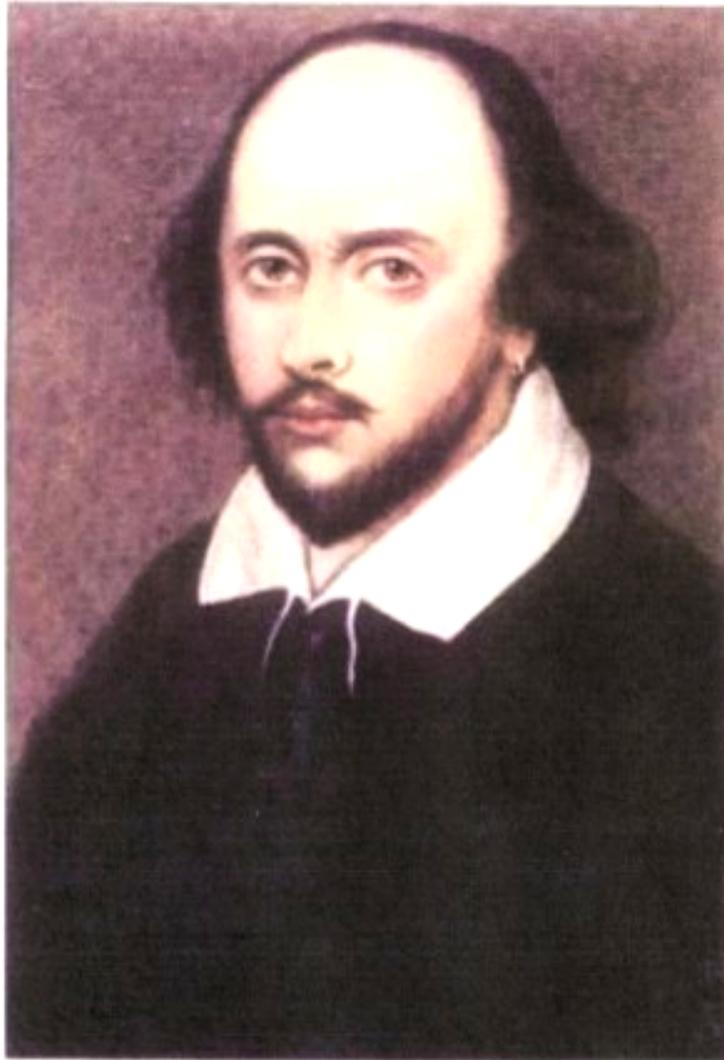
Shakespeare got this Right 400 years ago.

The Merchant of Venice

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"
- Geanakoplos 2003 "Liquidity, Default, and Crashes: Endogenous Contracts in General Equilibrium". Invited address World Congress 2000.
- 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"
- Geanakoplos-Zame 1997, 2002, 2005, 2009

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)
- Gorton-Metrick (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

<u>Standard Economic Theory:</u>

Equilibrium (supply = demand) determines interest rate.

<u>In my theory:</u>

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%. If banks hadn't been so leveraged, they wouldn't have lost so much money and we wouldn't have had bailout.

- 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. 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.

13

More Leverage
Higher Asset Prices

Low Leverage
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.

Leverage Cycle Crashes

X

New Optimists

New Marginal buyer

Public = Pessimists

Price falls more than any agent thinks it ought to because marginal buyer changes
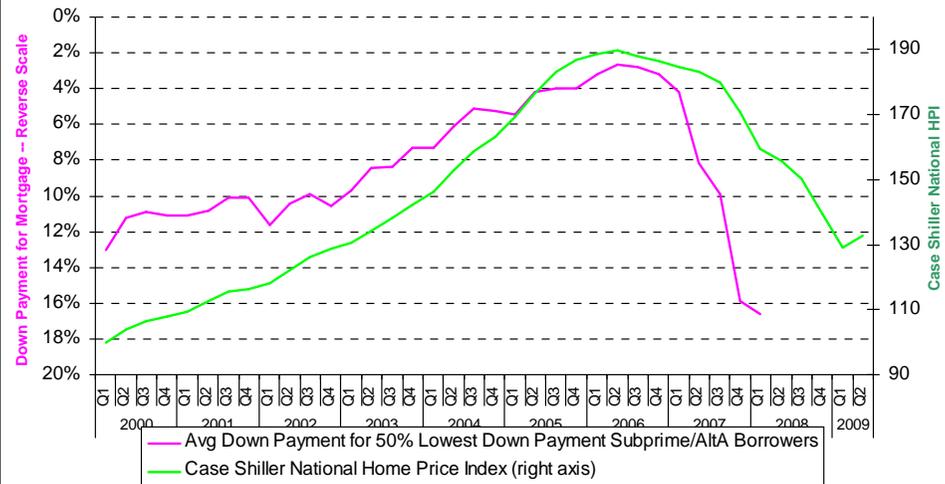
18

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

19

III. Recurring Leverage Cycles

- Tulip bulb craze in 1637 in Holland.
- Land boom and crash in 1920s in Florida before Depression.
- Land boom and crash in Japan in 1980s-1990.
- 1998 emerging markets and mortgages, bankrupted Long Term Capital
- 2007-9 subprime mortgage crash

20

The current leverage cycle

Housing Leverage Cycle
**Margins Offered (Down Payments Required) and Housing Prices**

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.

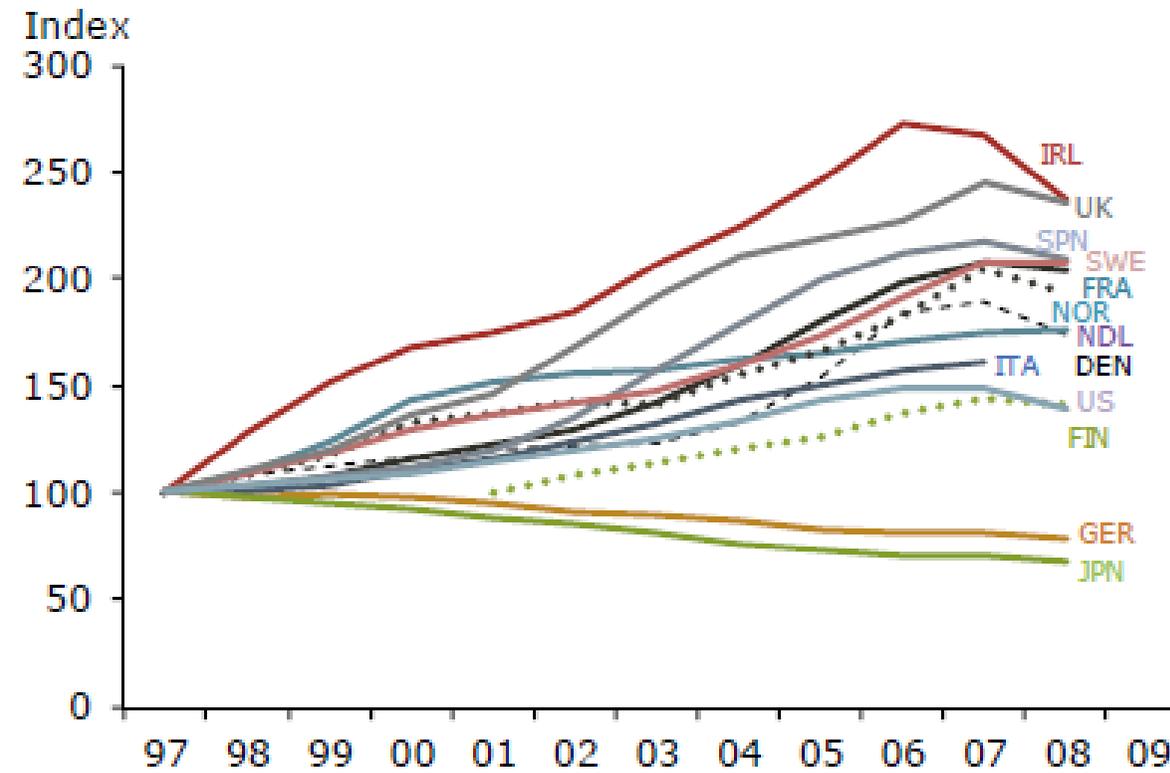Note Subprime/AltA Issuance Stopped in Q1 2008.

22

Figure 1
Household leverage ratios: Debt to disposable income
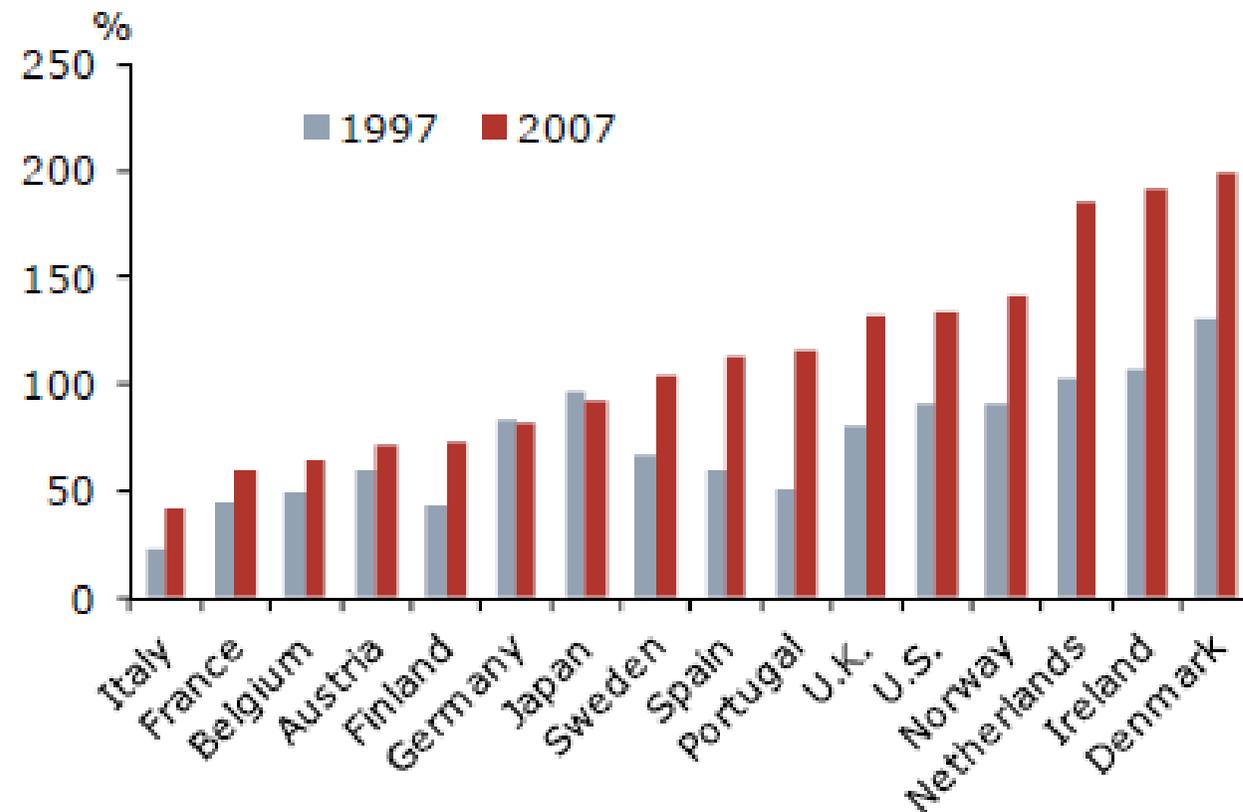
Note: The following countries use different data years: Japan 1997, 2006; Spain 2000, 2007; Ireland 2002, 2007.

Glick-Lansing FRBSF 2009

Figure 2
Real house prices, 1997-2008

Note: All series are indexed to 100 in 1997 except Finland, which is indexed to 100 at 2001.

Glick-Lansing FRBSF 2009

24

Leverage is debt to equity in this San Francisco Fed study

Figure 3
Household leverage and the run-up in house prices

% change in house prices, 1997-2007 (y-axis)
% point change in household leverage, 1997-2007 (x-axis)

Note: The plotted line depicts the best fit relationship in the data as generated by a simple least square statistical regression.
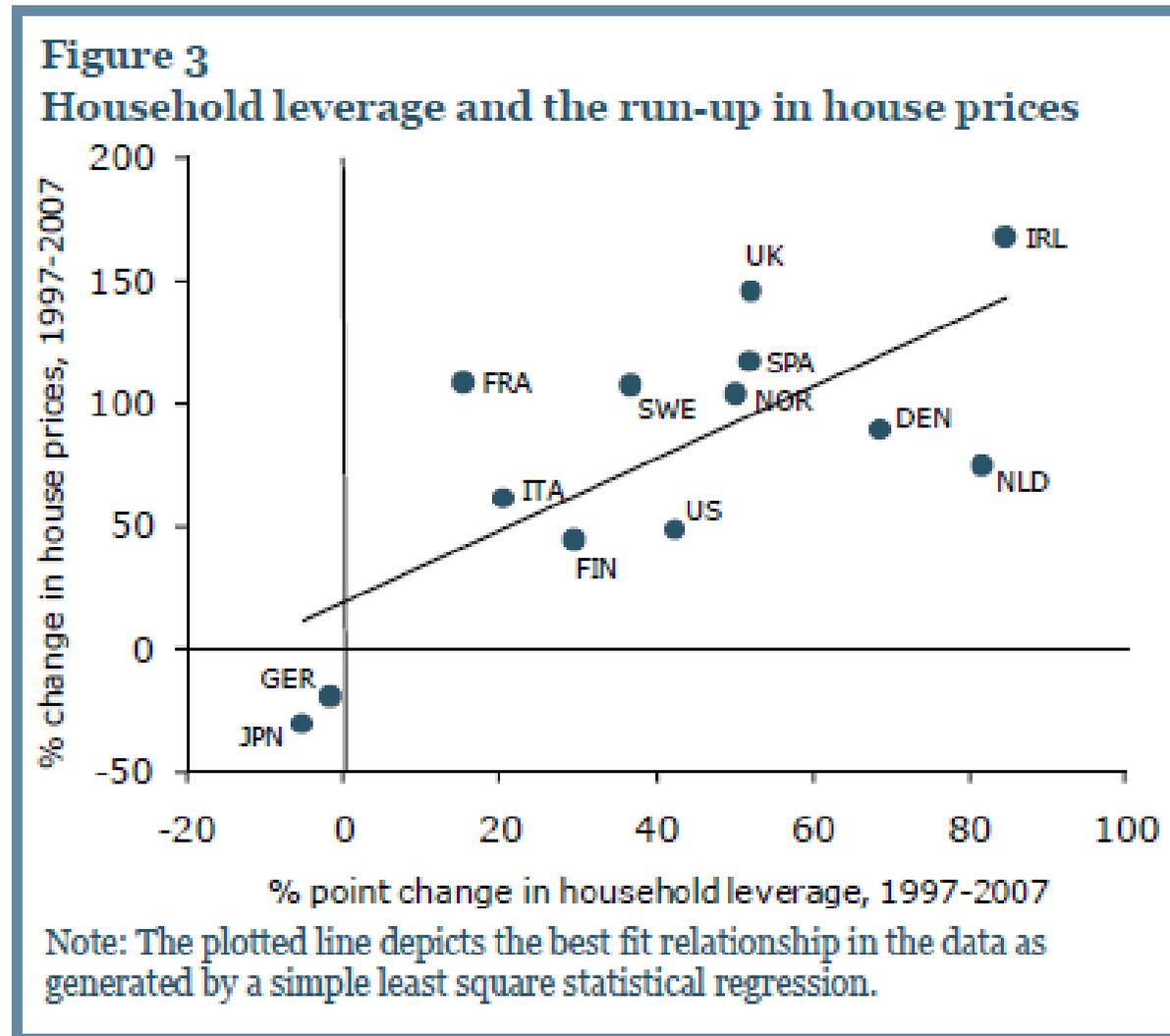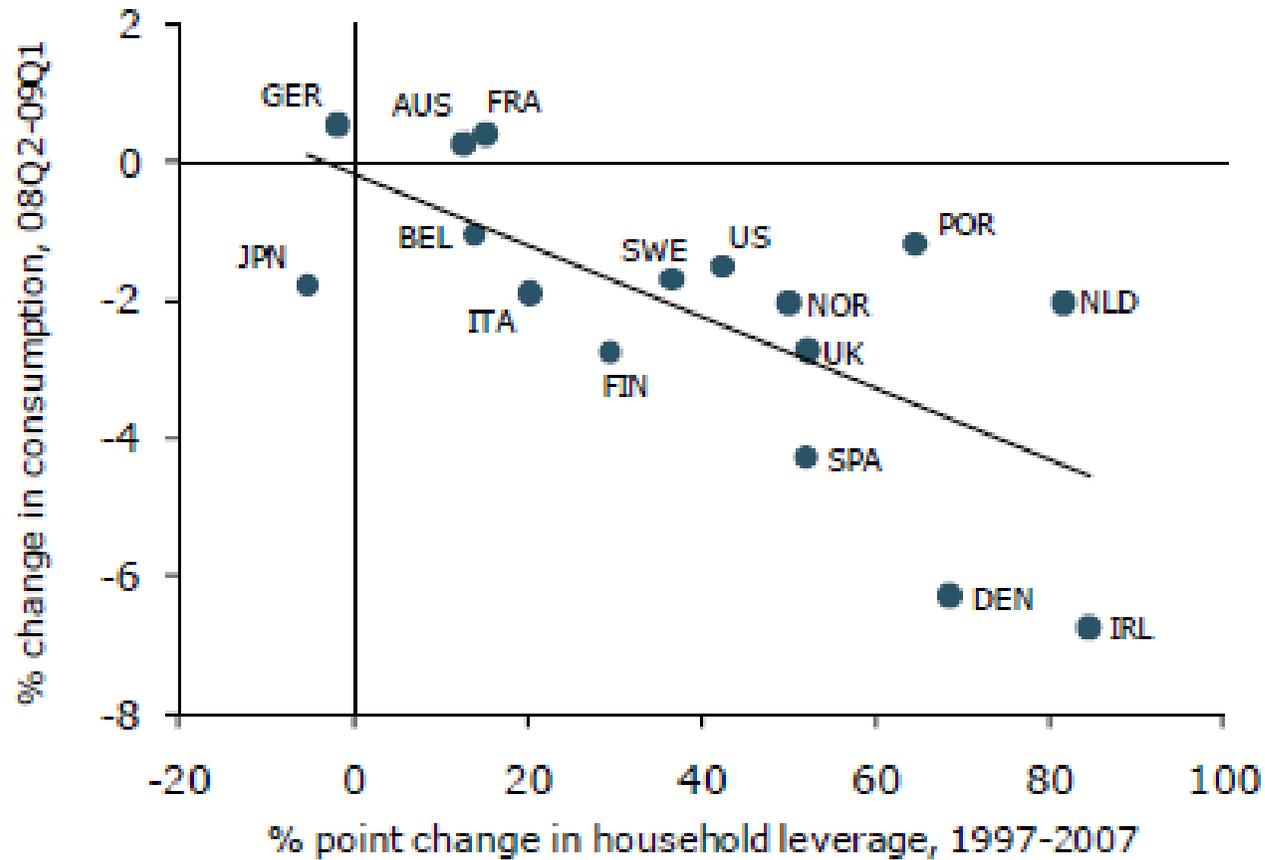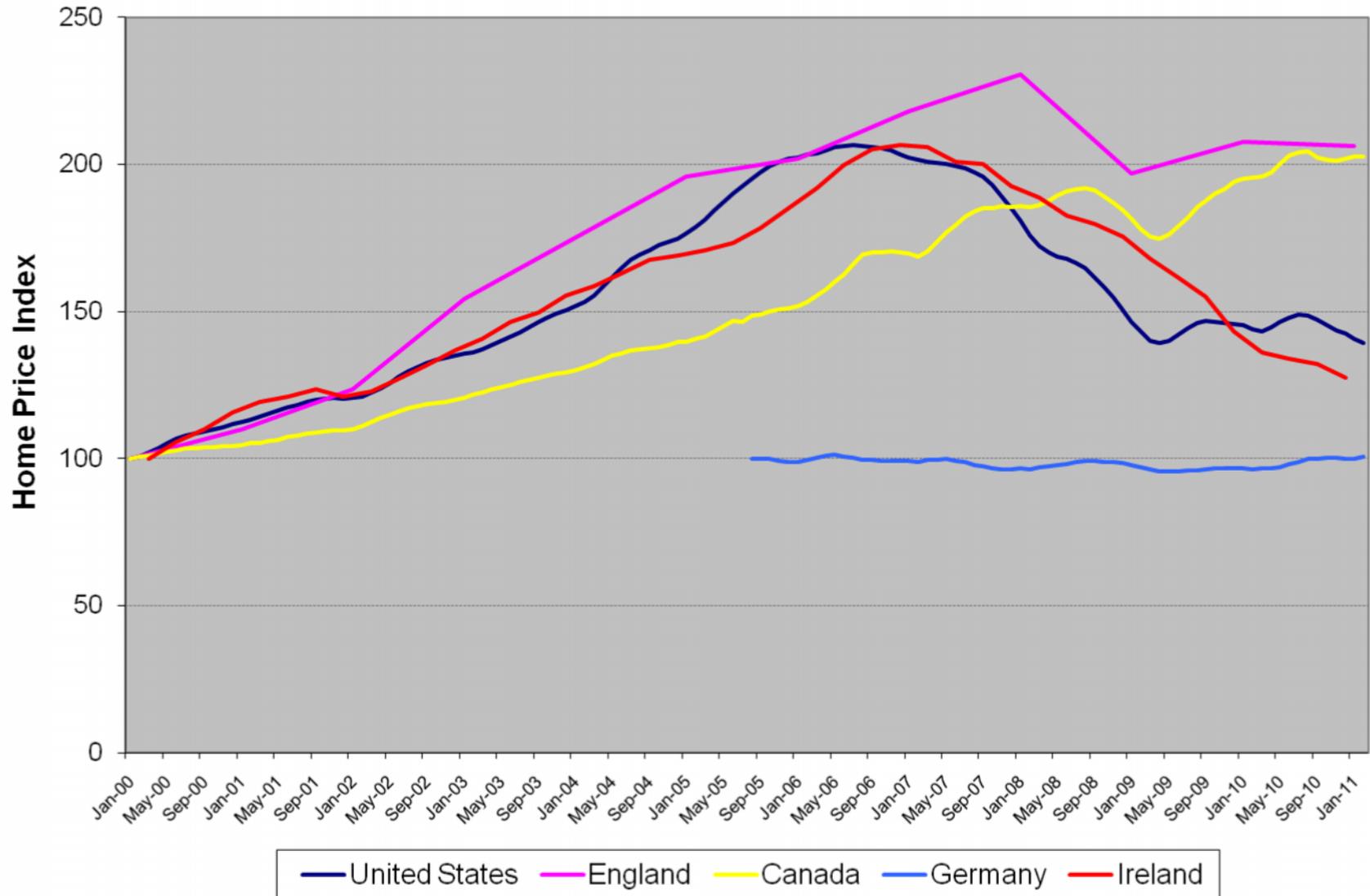
Glick-Lansing FRBSF 2009

Figure 4
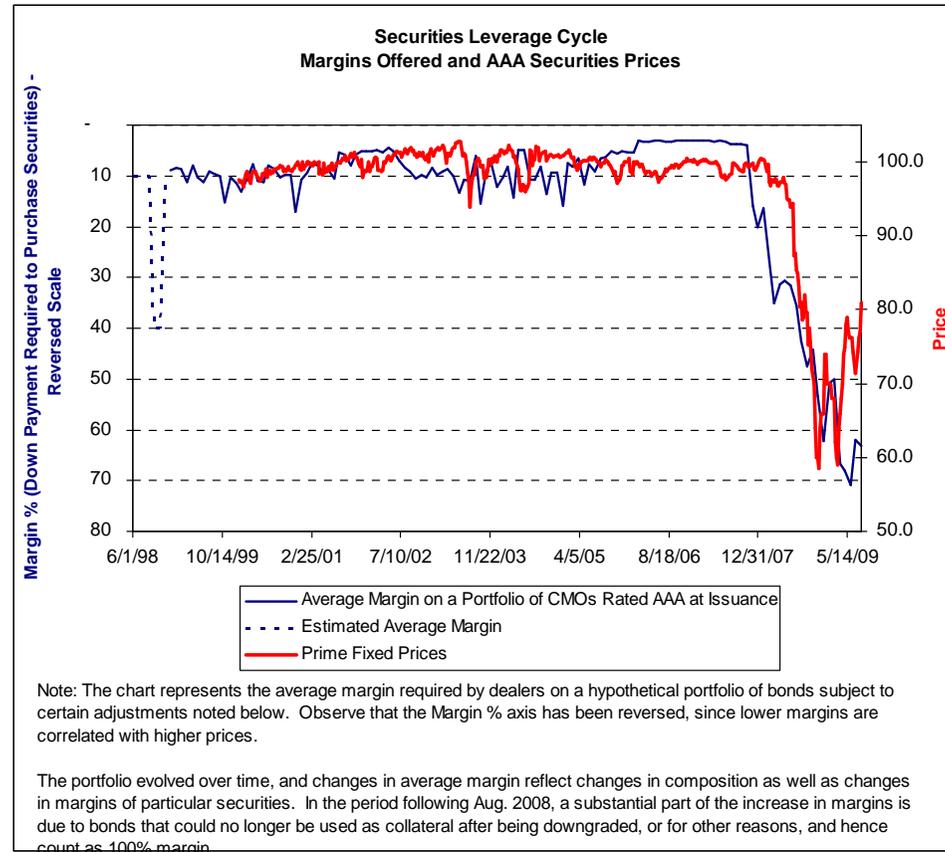Household leverage and the decline in consumption

Note: The plotted line depicts the best fit relationship in the data as generated by a simple least square statistical regression.

26

Home Prices by Country

All indices rescaled to Jan 2000 = 100, except Germany, which starts in 2005

Y-axis: Home Price Index (0, 50, 100, 150, 200, 250)

X-axis: Jan-00, May-00, Sep-00, Jan-01, May-01, Sep-01, Jan-02, May-02, Sep-02, Jan-03, May-03, Sep-03, Jan-04, May-04, Sep-04, Jan-05, May-05, Sep-05, Jan-06, May-06, Sep-06, Jan-07, May-07, Sep-07, Jan-08, May-08, Sep-08, Jan-09, May-09, Sep-09, Jan-10, May-10, Sep-10, Jan-11

Legend: United States — England — Canada — Germany — Ireland

Legend:
- USA
- JAPAN
- GERMANY
- FRANCE
- GB
- ITALY
- CANADA
- SPAIN
- AUSTRALIA
- NL
- BELGIUM
- SWEDEN
- SWITZERLAND
- DENMARK
- NORWAY
- FINLAND
- NEW ZEALAND
- IRELAND

X-axis: 1970, 1972, 1974, 1976, 1978, 1980, 1982, 1984, 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004

Repo Market Leverage

Securities Leverage Cycle
Margins Offered and AAA Securities 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.
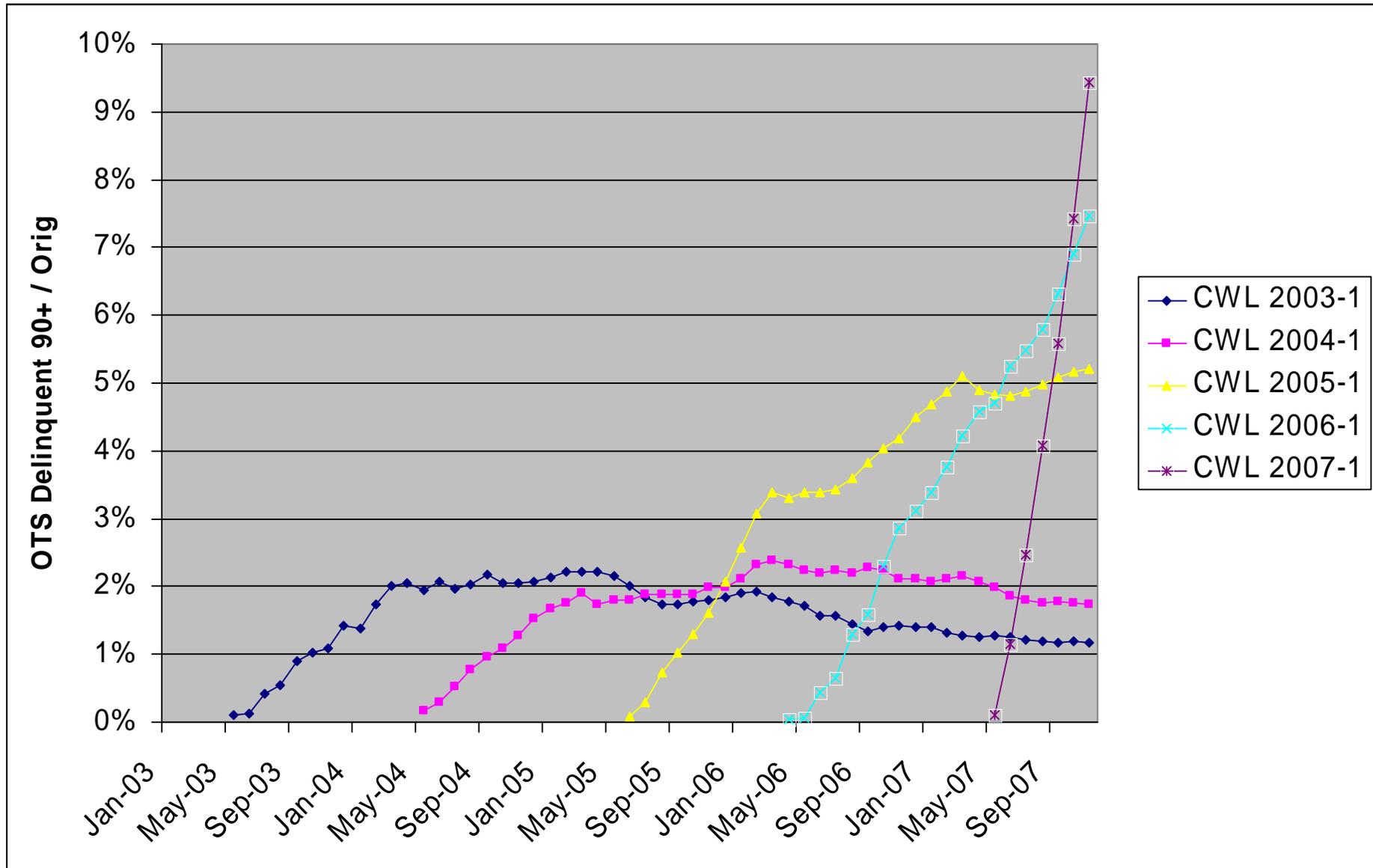
Look More Closely at Timing

Housing Leverage Cycle
Margins Offered (Down Payments Required) and Housing Prices

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.

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

33

BBB prices crash before big drop in housing

ABX.HE.A.06-1	ABX.HE.A.06-2	ABX.HE.A.07-1	ABX.HE.A.07-2	ABX.HE.AA.06-1
ABX.HE.AA.06-2	ABX.HE.AA.07-1	ABX.HE.AA.07-2	ABX.HE.AAA.06-1	ABX.HE.AAA.06-2
ABX.HE.AAA.07-1	ABX.HE.AAA.07-2	ABX.HE.BBB.06-1	ABX.HE.BBB-.06-1	ABX.HE.BBB.06-2
ABX.HE.BBB-.06-2	ABX.HE.BBB.07-1	ABX.HE.BBB-.07-1	ABX.HE.BBB.07-2	ABX.HE.BBB-.07-2
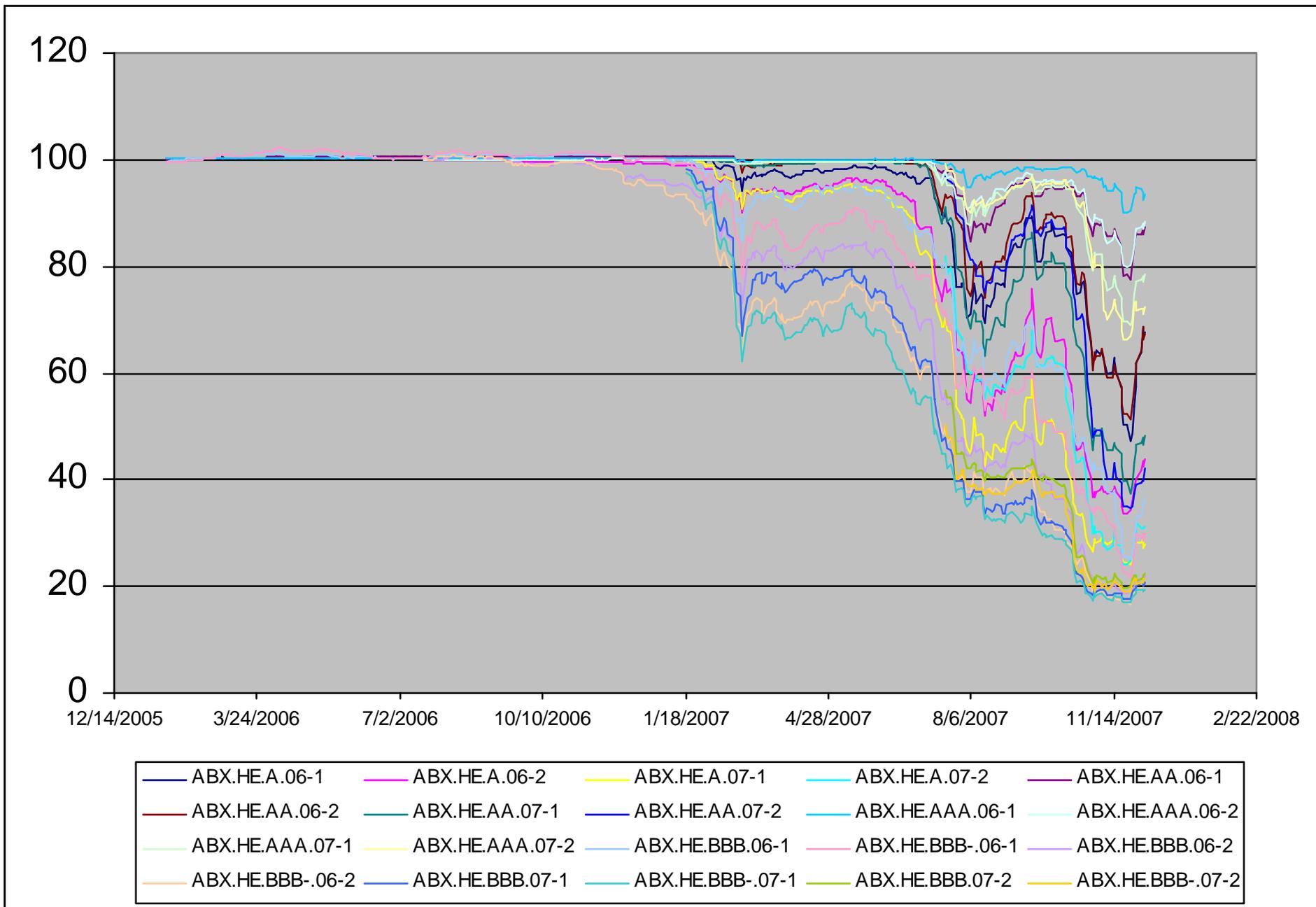
IV. 2007-9 Worst Leverage Cycle because

- 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

Financial Innovation also a Cause

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.

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.

Tranching

- A more sophisticated kind of leverage, with even greater effect on price.

40
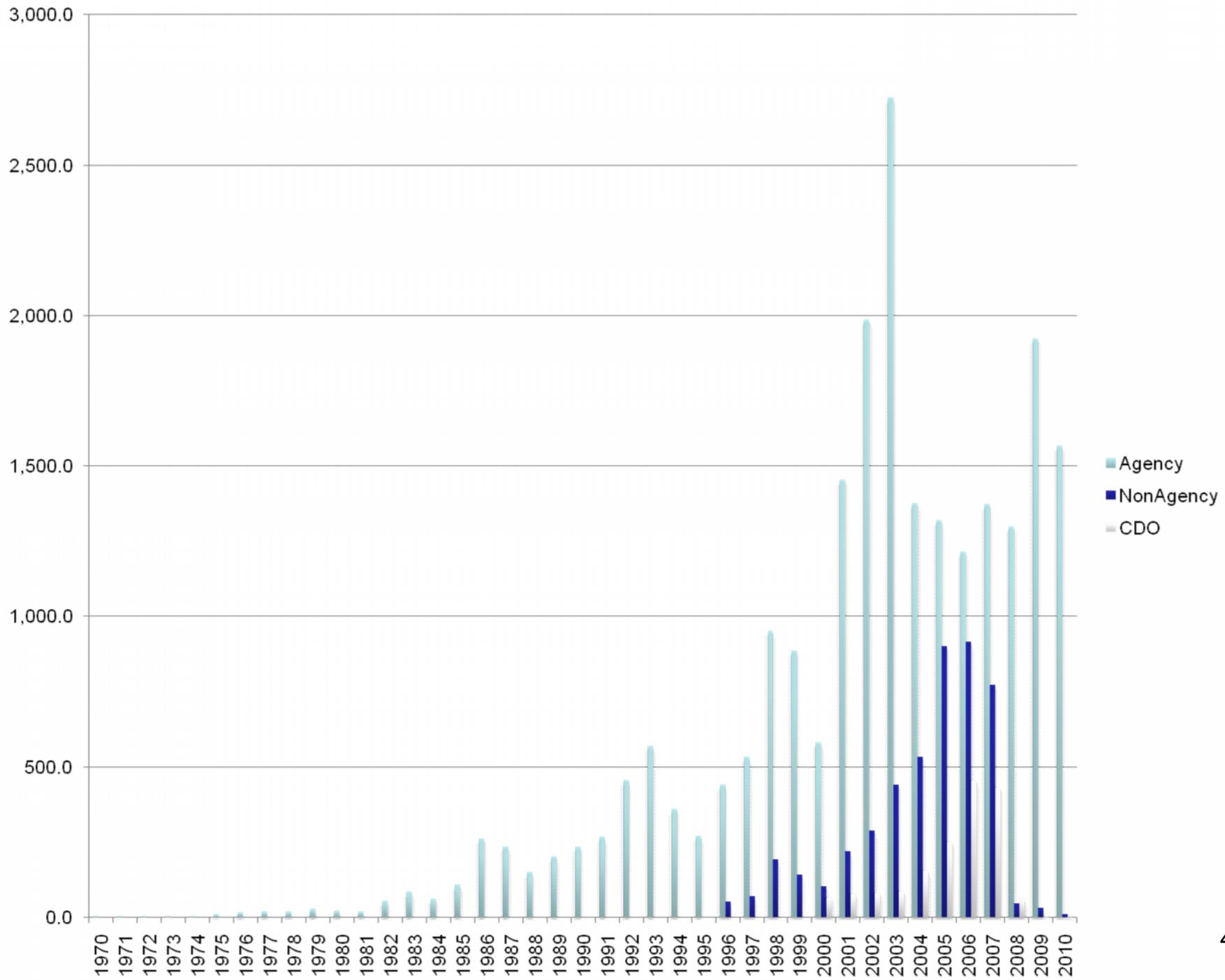
Leverage Cycle and CDS

- 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.

Source: IBS OTC Derivatives Market Statistics
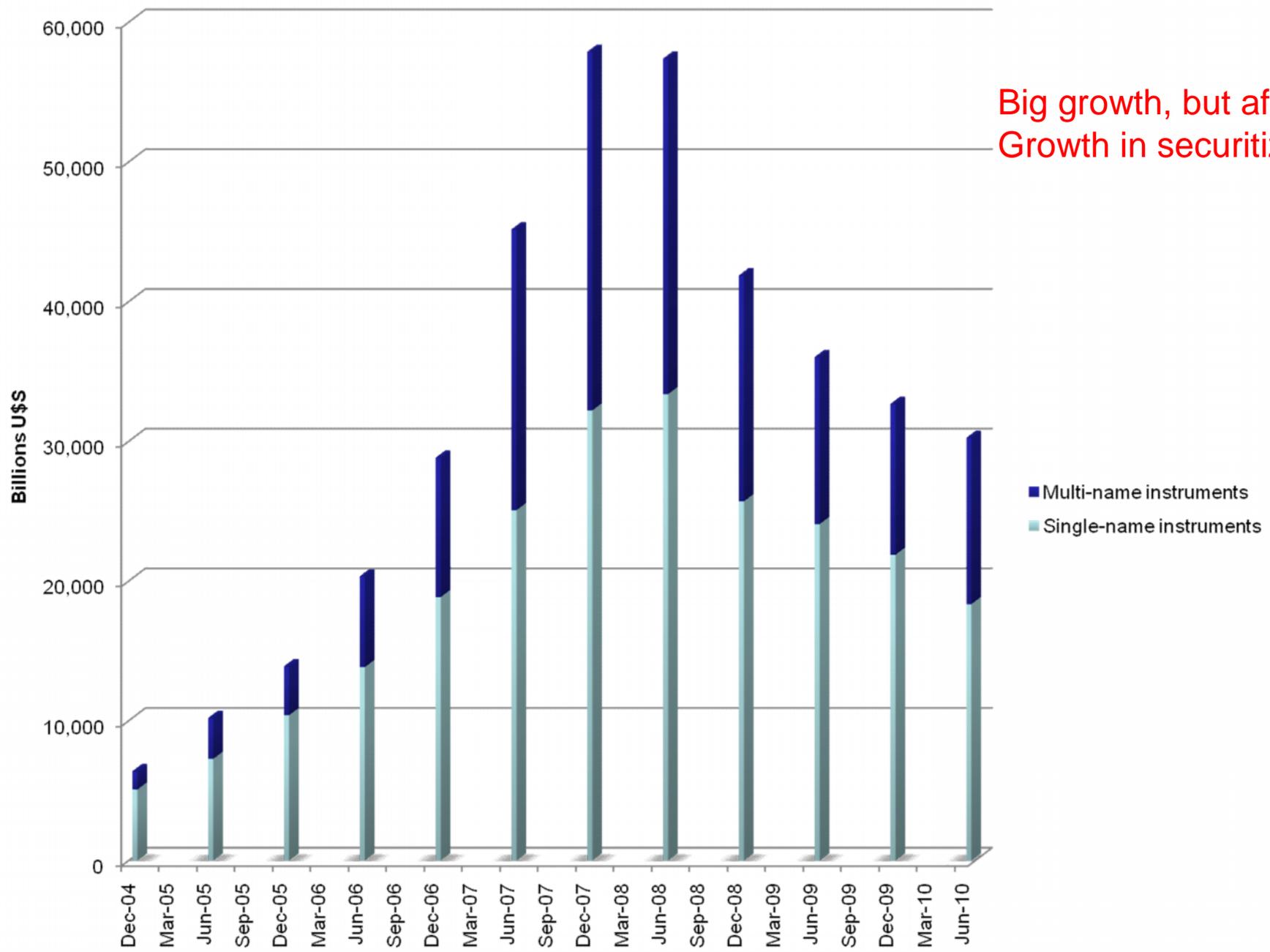
Big growth, but after Growth in securitization

42

Non-Leverage Economy t=0

Unexpected Introduction of Tranching at t=2

Unexpected Introduction of CDS at t=3

Unexpected introduction of Leverage at t=1

43
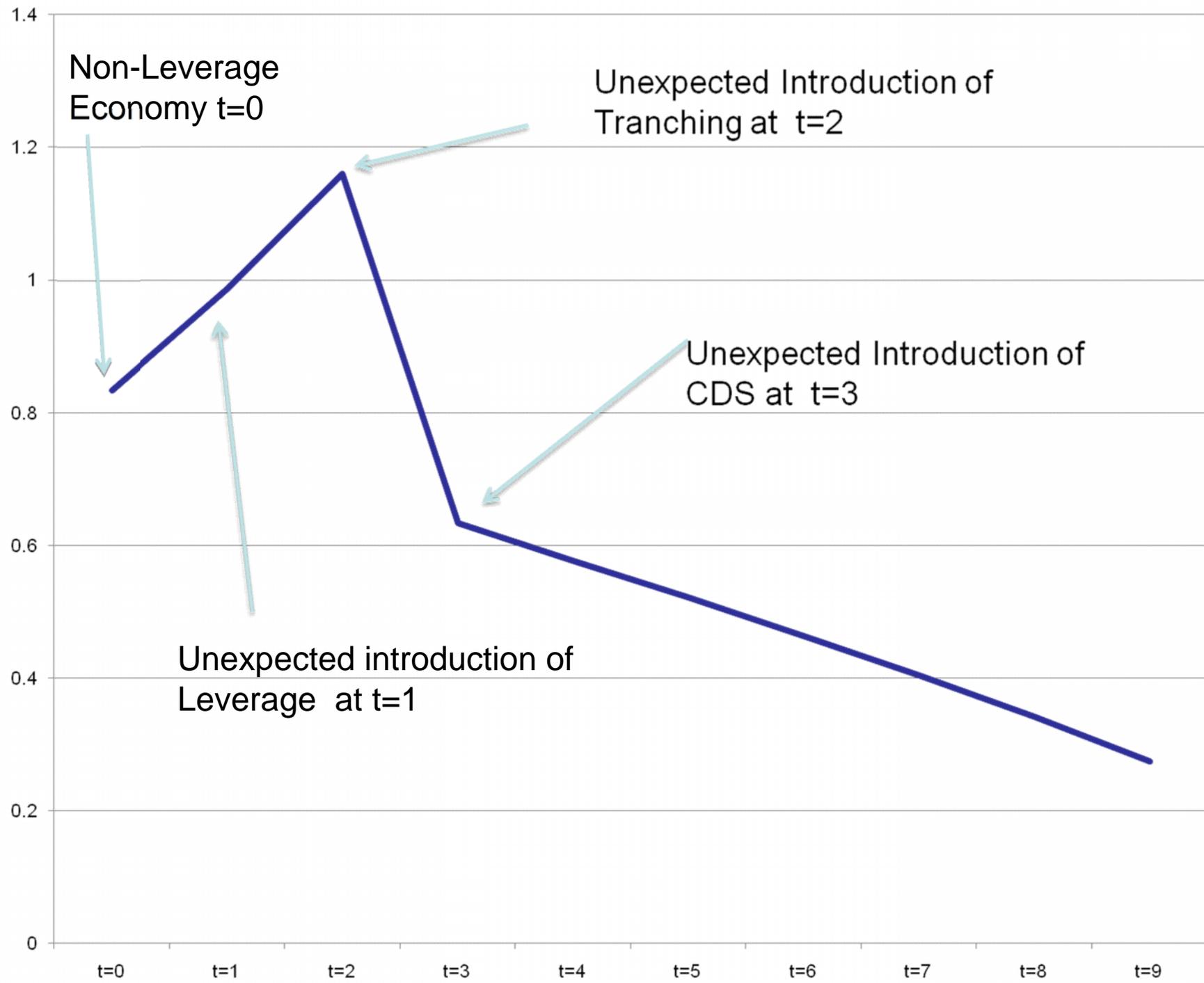
What's so bad about so much leverage? (1) Debt and Default

- 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.
  - Re-leverage the system by going around banks to lend with less collateral. TALF, PPIP Establish a permanent facility.
  - 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

- Geanakoplos-Koniak in October 2008 NY Times Op-Ed "Mortgage Justice is Blind" explained why Servicers would never do proper modifications. Advocated community bankers.

- NY Times Op-ed March 2009 "Principal Matters" advocated writing down principal as only solution.

50

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!
- Example: $160,000 loan, $100,000 house. Could write down to $80,000 or $90,000.

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

06-2 Indices

- ABX (Subprime)
- Option ARM
- Alt-A ARM
- Alt-A Fixed
- Prime ARM
- Prime Fixed
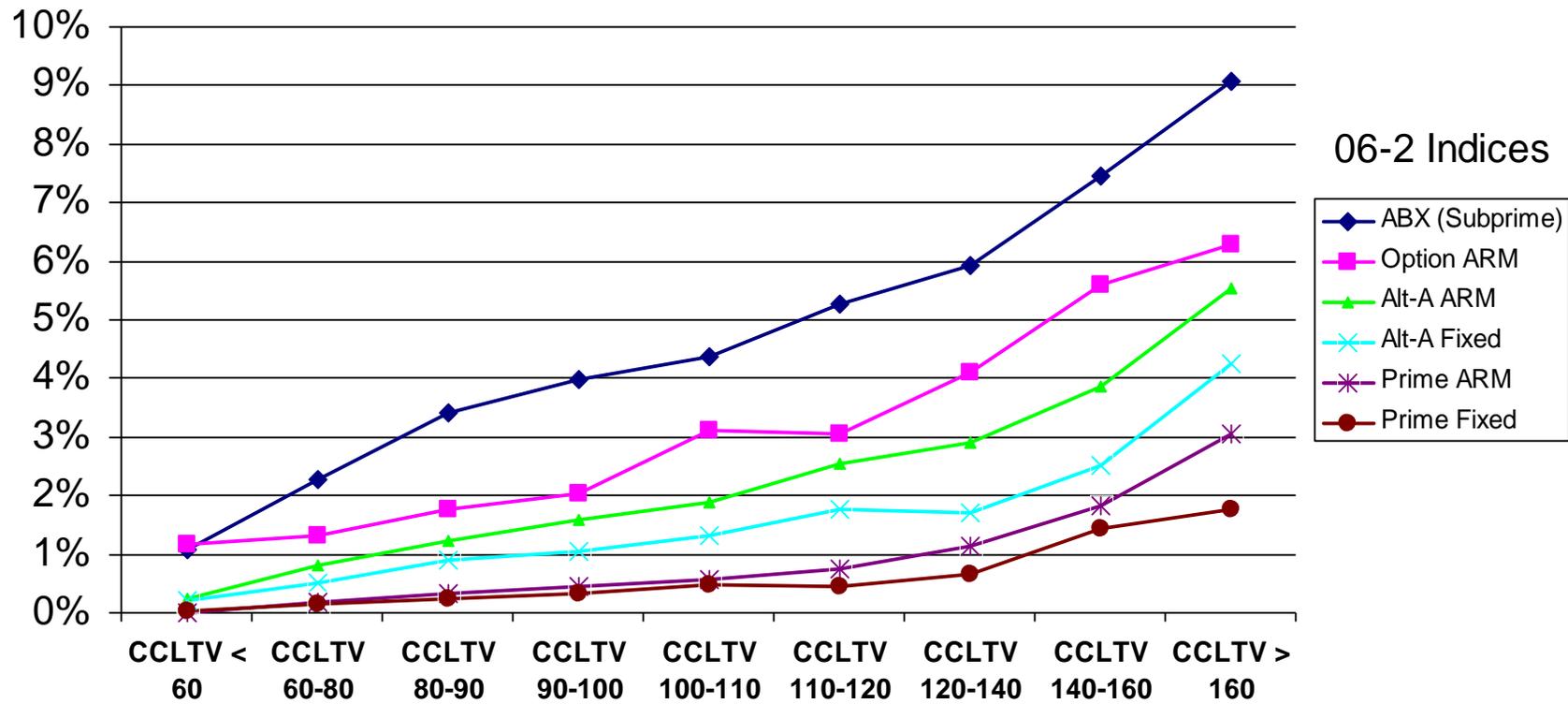
Non-Agency Securitized Monthly Default Rate
Dec 2010 - Feb 2011

Y-axis: 0.0%, 1.0%, 2.0%, 3.0%, 4.0%, 5.0%, 6.0%

X-axis: 0, 50, 100, 150, 200, 250, 300
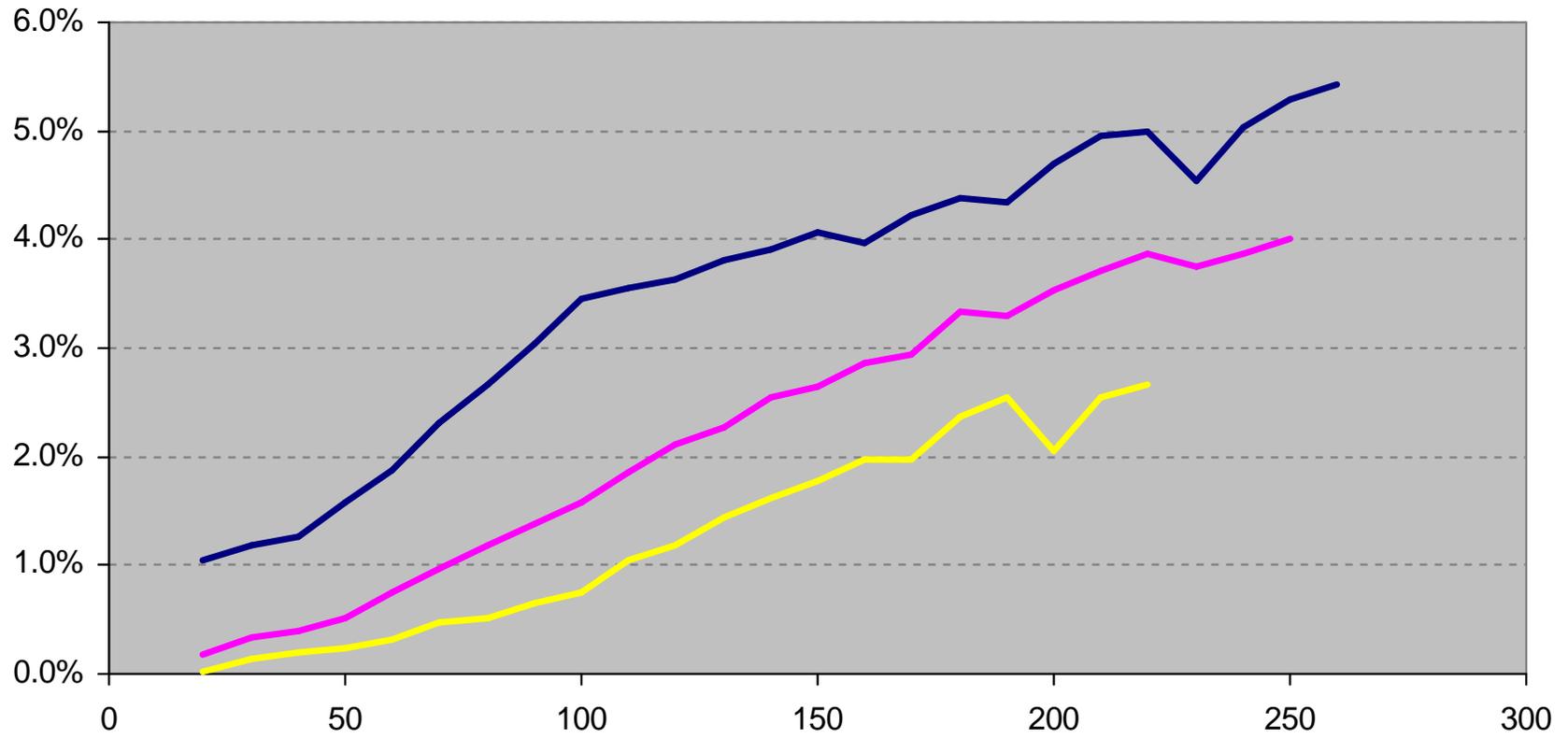
Current Combined Loan to Value Ratio (%)

Legend: Subprime — AltA — Prime

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
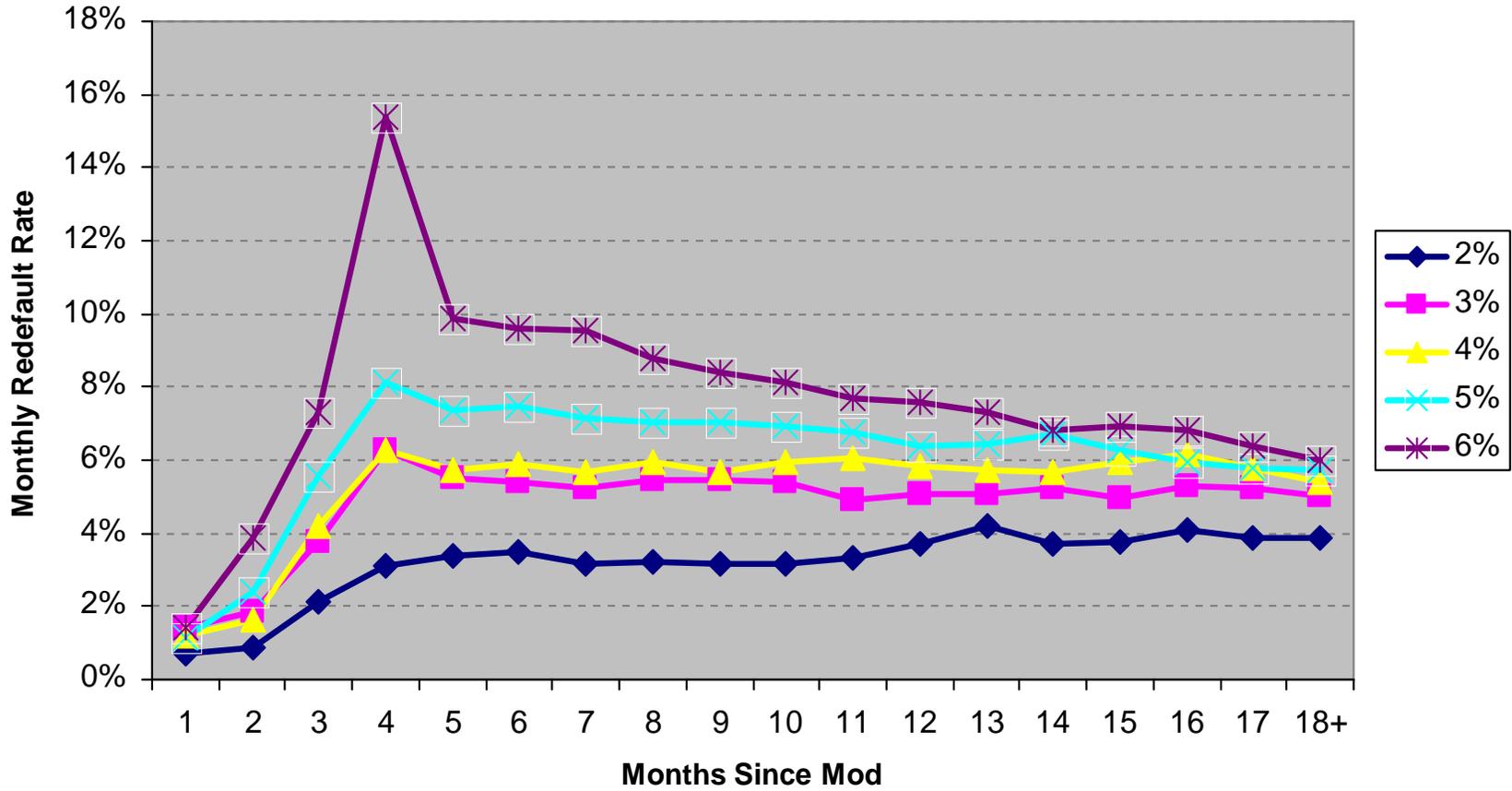
Subprime Cumulative Recidivism by Coupon and Months Since Mod
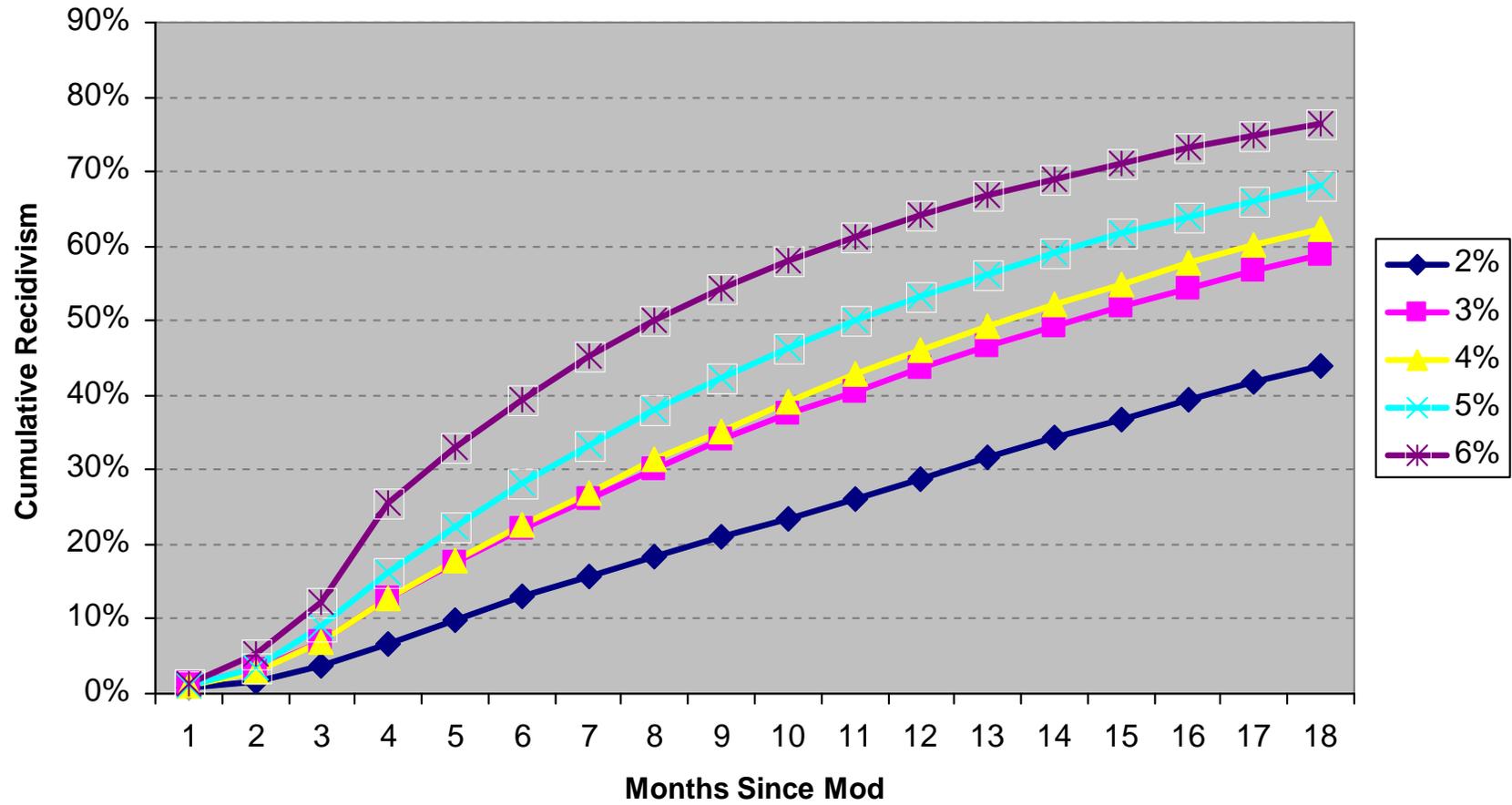
Default, Punishment, Forgiveness

- 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

Leverage Cycle example adapted from Geanakoplos 2003

Natural Buyers-Margins Theory of Crashes

h=1

optimists

e = (1 security, $1)

public

at date 0

Securities and $ durable

h=0
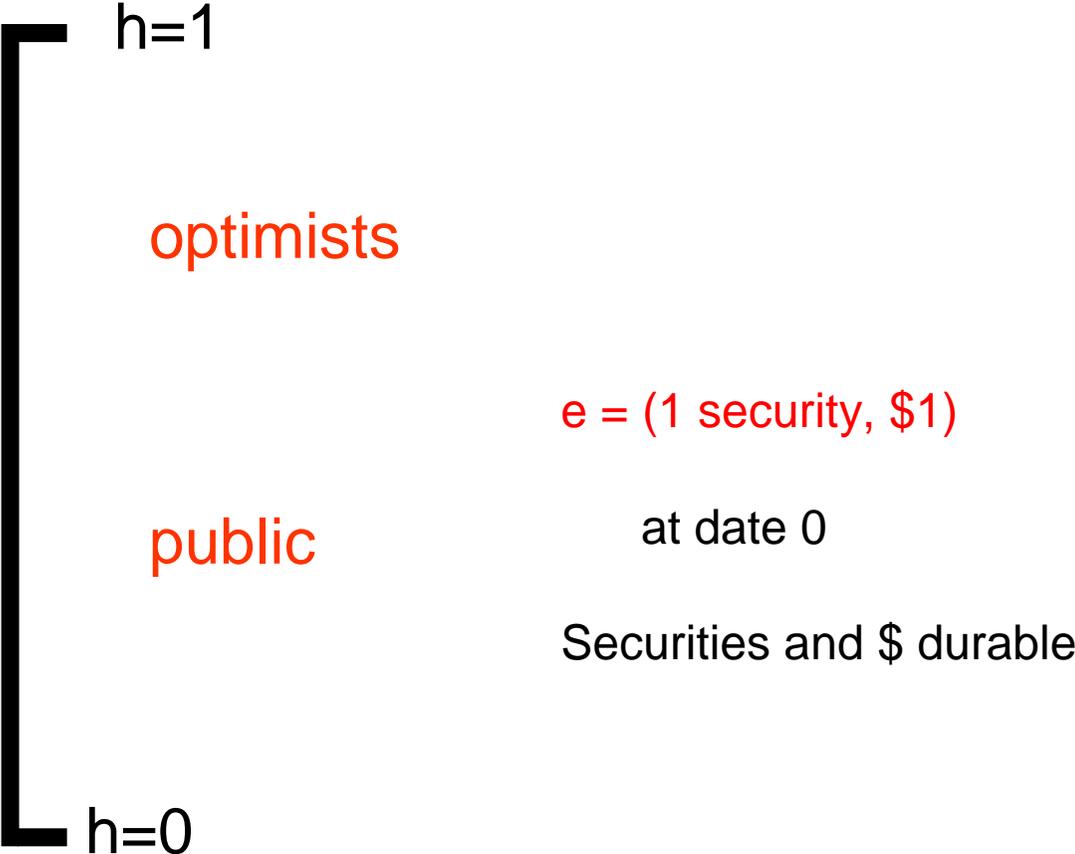
Endogenous Collateral with Heterogeneous Beliefs: A Simple Example

Let each agent $h \in [0,1]$ assign probability h to $s = U$ and probability $1 - h$ to $s = D$. Agents with h near 1 are optimists, agents with h near 0 are pessimists.

Figure 2

U
$Y=1$

0

h

$1 - h$

D
$Y=.2$
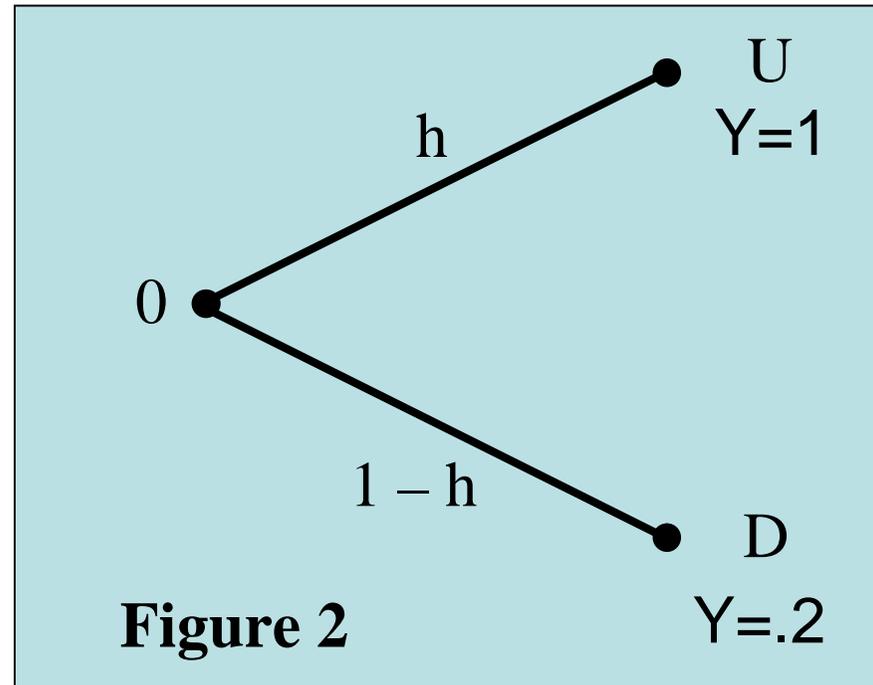
Suppose that X is perfectly durable if warehoused and extinguished if consumed (like tobacco). Suppose that 1 unit of Y gives 1 unit of X in state U and $R=.2 < 1$ units of X in D. Suppose each agent has one unit of X and one unit of Y at 0 and nothing else.

Continuum of agents H= [0,1]

Risk neutral. No discounting

$$U_h = c_0 + h\, c_U + (1-h)\, c_D$$

Endowment only at t=0:

1 unit of durable consumption and 1 unit of the asset

Natural Buyers

Borrowers

1

Natural buyers

a

Lenders

public

h
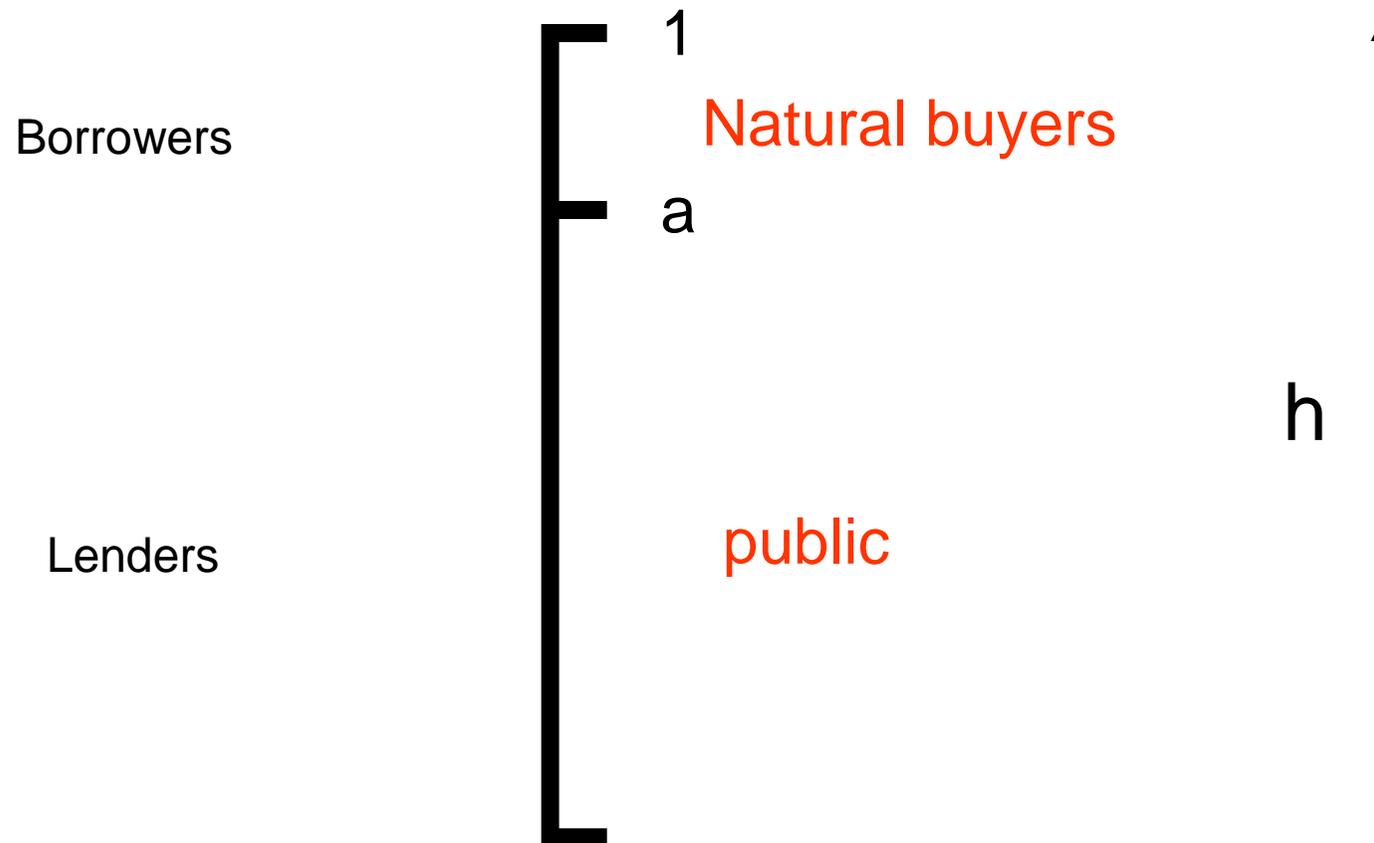
Leverage Affects price

- The more the optimists can borrow, the fewer of them will be needed to buy all the assets, and the higher will be the price.

Leverage affects price
What determines leverage?

- Suppose all loans promise equal amounts of X in both states. $A_j = (j,j)$

- Suppose no-recourse collateral of Y.

- How much will you be able to borrow using one factory as collateral in equilibrium?

- Would think big optimists would be willing to pay higher interest in order to use less collateral, so maybe many contracts actively sold.

- How can supply = demand determine two variables, interest rate and collateral rate?

Contract

- Terms: (Promise, Collateral)

- $$(A_j, C_j)$$

- Price π_j

Contracts at state D

- ((.2,.2), 1 security) delivers (.2,.2)
- price = .200, r = 0%.

- ((.3,.3), 1 security) delivers (.3,.2)
- price = .261, r = 15%. No trade in equilibrium.

- ((.4,.4), 1 security) delivers (.4,.2)
- price = .322, r = 24%. No trade in equilibrium.

Equilibrium Leverage

- Just one contract will be traded, the one where 1 factory collateralizes a loan of .2.

- In this example it happens to be the maximal borrowing that has no chance of default.

- Borrowers are agents $h > a$, and lenders are agents $h < a$.

Why Just One Collateral Rate

- If no more delivered in D, and more is borrowed, then much more must be delivered in U.

- But that means the borrower is paying more in the state U he is almost sure will happen, and the lender is receiving money in a state he is almost sure will not happen. No deal!

Solving the Example

- Assume only the contract with promise (R,R) and collateral 1Y is actively traded.

- Then there will be no active default.

- π_R will be equal to 1 (interest rate 0).

- Some agent $a \in (0,1)$ will be indifferent to buying or selling Y at time 0. Agents h>a will buy all they can afford of Y (after selling their X and borrowing to the max) and agents h<a will sell Y and lend. Agent a is the marginal buyer.

$$P = .75 = .69(1) + .31(.2)$$

h=1

optimists

h=a =.69

pessimists

h=0
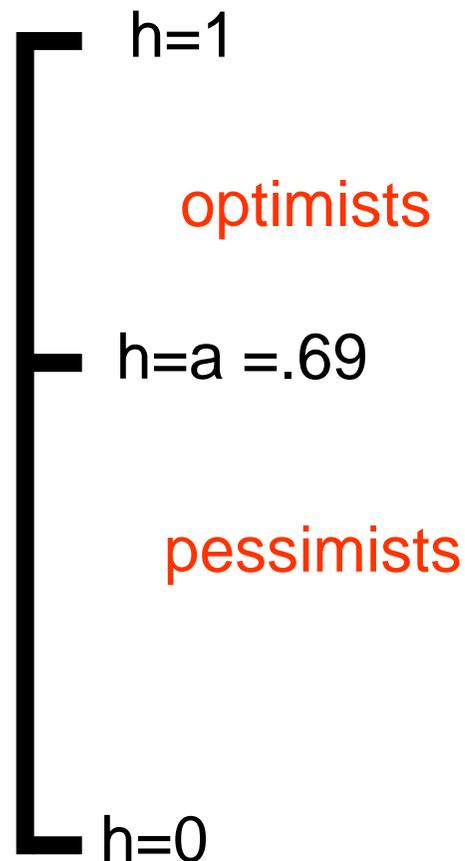
Optimists spend all wealth and leverage to max, end up consuming only at U.
Pessimists lend and hold gold, ending up with equal consumption at U and D.
Leverage enables the optimists to create and hold the Up Arrow security.

More solving the example

- The total money spent on Y by agents h in (a,1) is all their endowment of X plus the money R they borrow on each unit of Y they owned plus the money R they borrow on each unit of Y they buy

- $p_{0Y} = [1(1-a)+1(.2)]/a = .51/.69 = .75$

- The marginal buyer a is indifferent

- $p_{0Y} = a1+(1-a)(.2) = .69 + .06 = .75$

- Two equations in two unknowns a, p_{0Y}.

Leverage Cycle

Leverage Cycle starts before scary news.
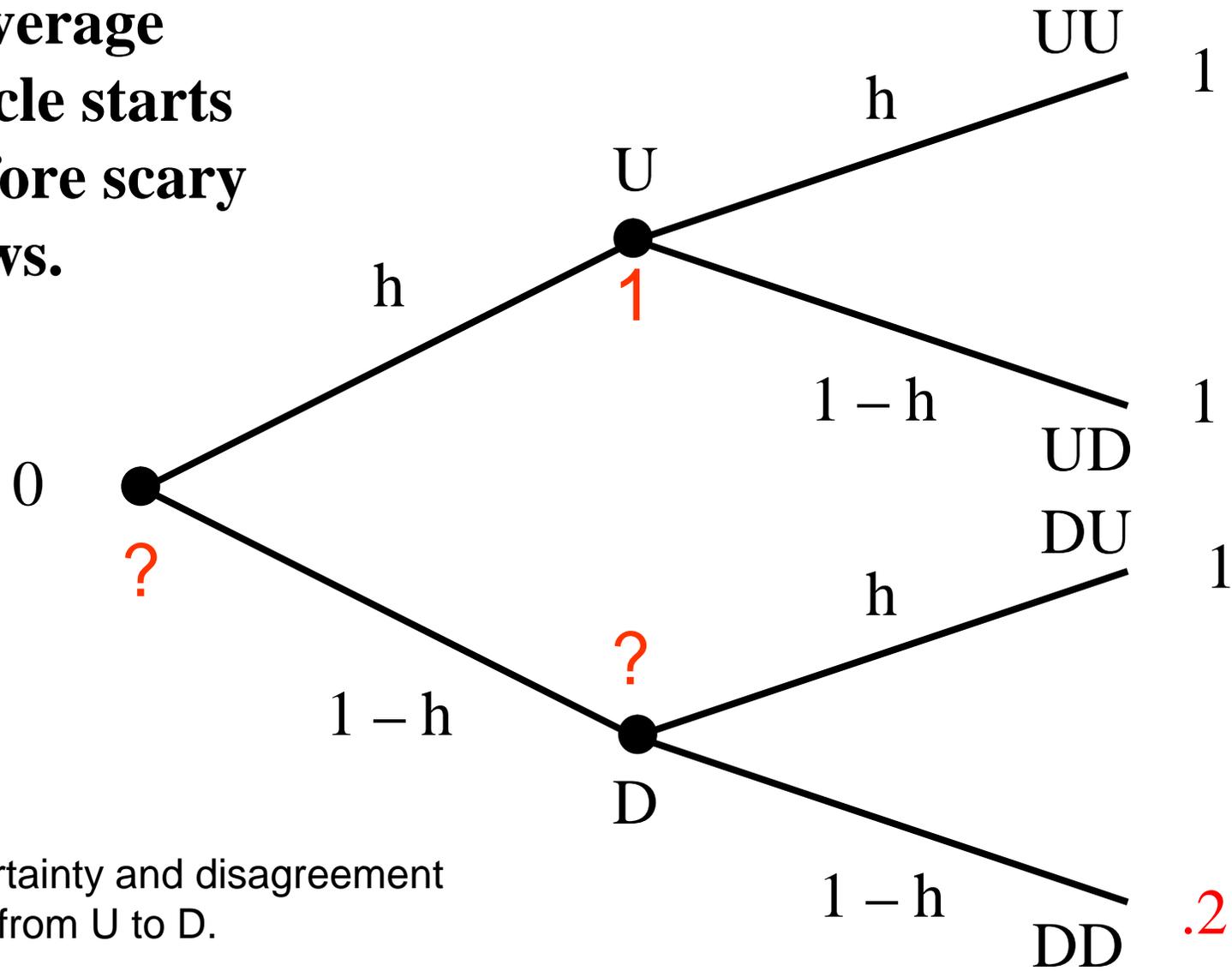
Uncertainty and disagreement grow from U to D.

79

Marginal buyer = .87.

UU
1

h

U
1

h

1 − h

1

UD

.95

DU

0

h

1

.69

1 − h

h

D

1 − h

.2

DD
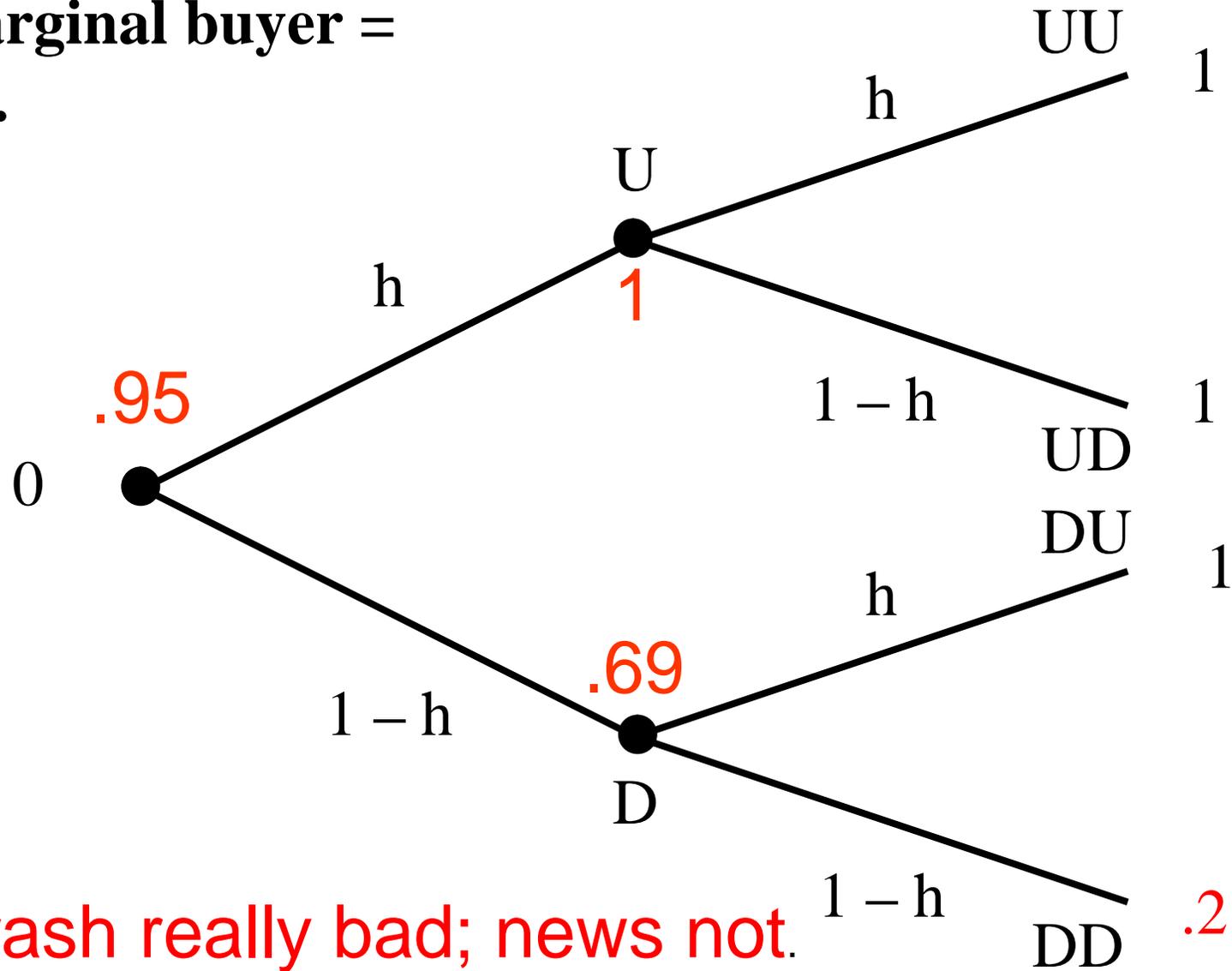
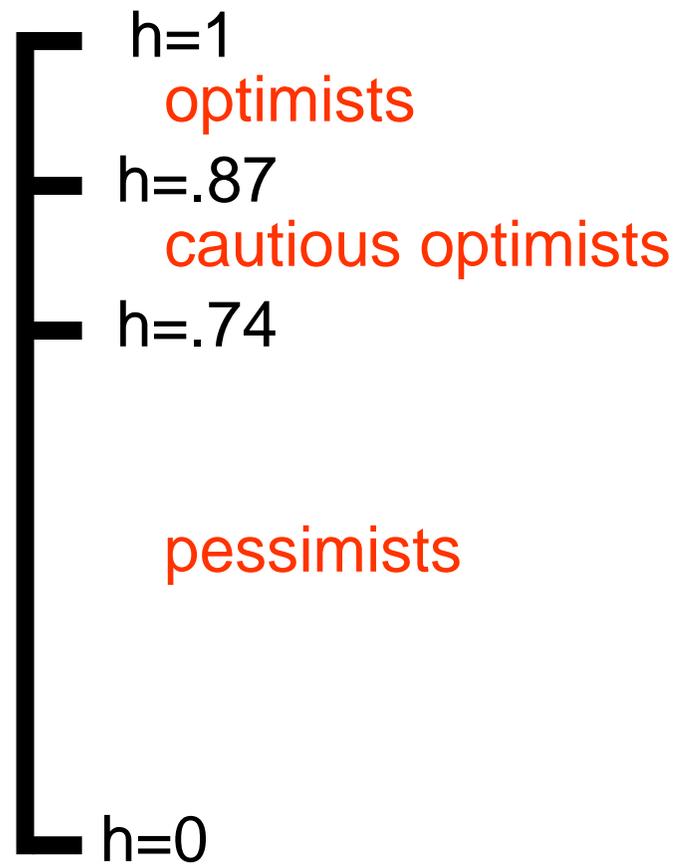Crash really bad; news not.

Top 13% of buyers go bankrupt.

Leverage at 0 = .95/.26 = 3.6; Leverage at D = .69/.49 = 1.4

80

Interest rates = 0.

Natural Buyers-Margins Theory of Crashes

h=1

optimists

h=.87

public

h=0
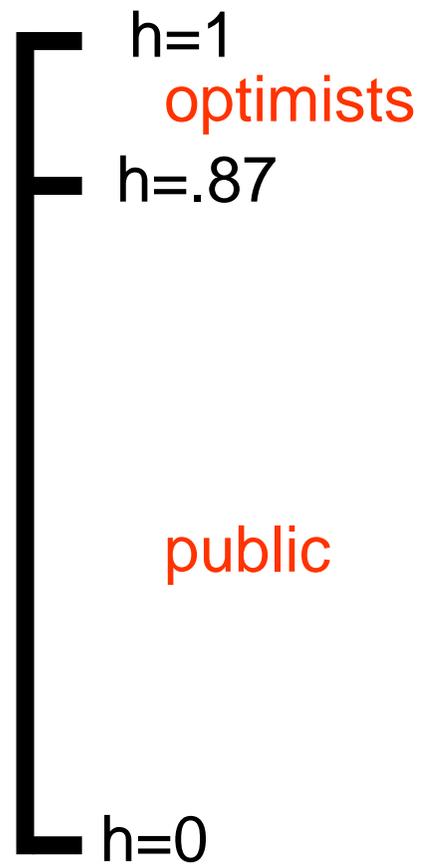
Nobody thinks price should go down 26 points on basis of his own information.

X

h=.87

new optimists

h=.61

pessimists

h=0
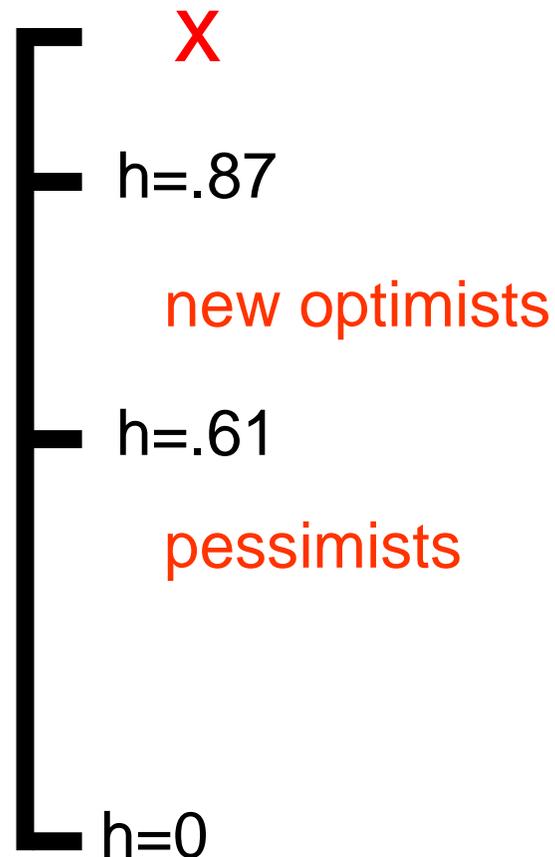
Optimists spend all wealth and leverage to max at 0, end up consuming only at U.
New Optimists lend at 0, leverage to max at D, consume at U and DU.   82
Pessimists lend and hold gold, ending up with equal consumption at U, DU, DD.

Why is .87 the marginal buyer?
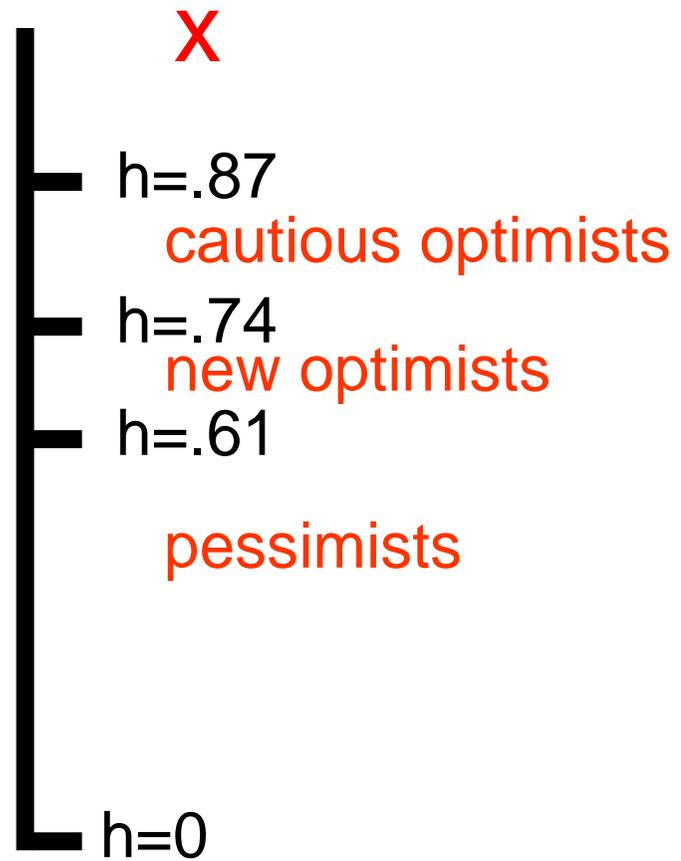
Holding dry powder. Not many Buffets.

.95

0

1

.69

h

1 – h

h

1 – h

h

1 – h

h

1 – h

U

D

UU

1

UD

1

DU

1

DD

.2

Crash really bad; news not.

Leverage at 0 = .95/.26 = 3.6; Leverage at D = .69/.49 = 1.4

Interest rates = 0.

Rational Agents.

h=1
  optimists

h=.87
  cautious optimists

h=.74

pessimists

h=0

X

h=.87

cautious optimists

h=.74

new optimists

h=.61

pessimists

h=0

Equations

- Marginal buyers a at 0 and b at D
- P(D) = b1 + (1-b)(.2)
- P(D) = [(a − b) + a(.2)]/b
- P(0) = [(1 − a) + P(D)]/a
- MUY(a) = a*1 + (1-a)*P(D)*a/b
- MUX(a) = a*1 + (1-a)*a/b
- P(D)/1 = MUY(a)/MUX(a)

Endogenous Maturity Mismatch

- If two-period loans were available, they would appeal to borrowers, because then if D happened they would not get margin calls, they could ride out the storm and still come out ahead.

- But in equilibrium they would all take out one-period loans.

- Because just cannot borrow enough for two periods.

Model Needs Extending

- In model loans are one period. With mixture of short and long loans crisis will create agents who are underwater but able to make bond payments in short run.

- Depending on their expectations about the future they will or will not default at once.

- Crisis is extended by period of uncertainty about who will go bankrupt.

Aftermath of Crash

- Many people and businesses will be underwater. When underwater, agents' personal incentives do not promote social welfare.

- Aftermath duration depends on how big the cycle was and how effective government intervention is.

Tranching, CDS and Asset Pricing
Fostel-Geanakoplos 2011

In leverage cycle, collateral amplifies shocks. With financial
Innovation, economy itself can cause cycle without shocks
If the order of innovation is bad.

Tranching, CDS and Asset Pricing Fostel-Geanakoplos 2011

- Securitization and Tranching of assets into derivatives in 1990s and 2000 seems to have raised the prices of underlying assets. Indeed that is why government promoted it.

- So why should creation of CDS outside the securitization lower the price of assets? Is it because there is no tranche that looks like a CDS?

BASELINE MODEL

Asset Payoff

U
$\bullet$ 1

1 $\bullet$
h

1-h

D
$\bullet$ $R < 1$
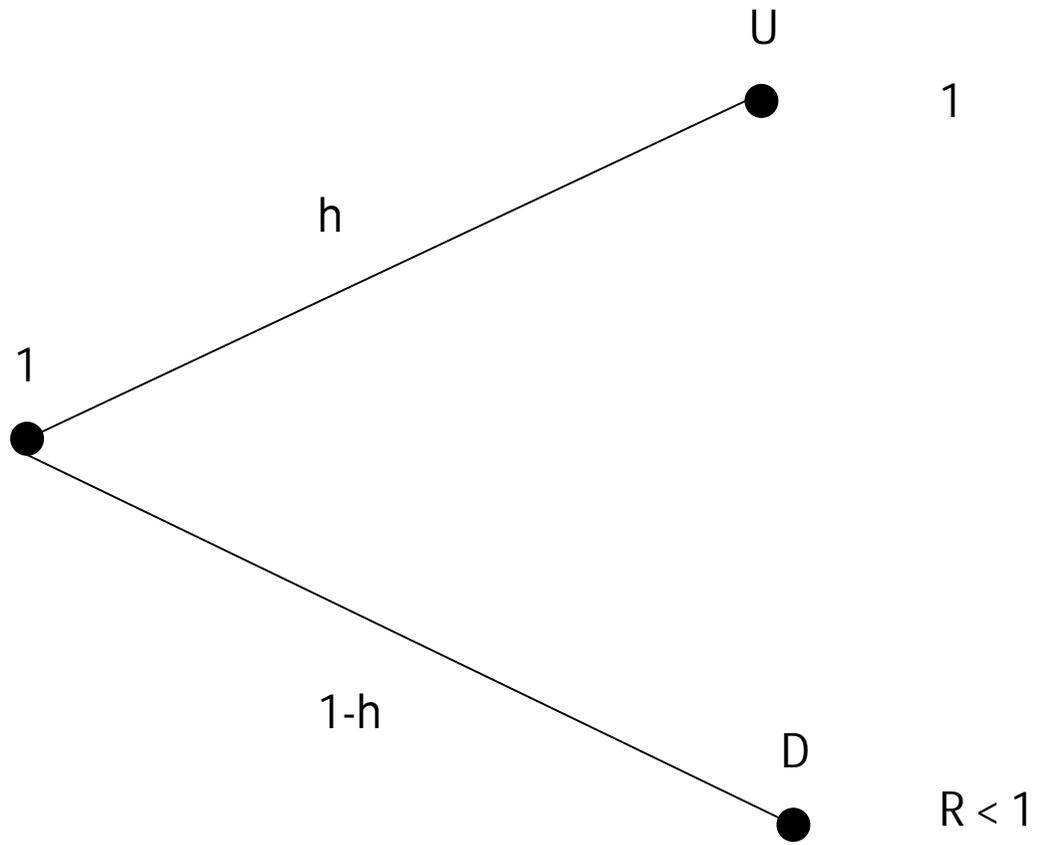
Continuum of agents H= [0,1]

Risk neutral. No discounting

$$U_h = c_0 + h\, c_U + (1-h)\, c_D$$

Endowment only at t=1:

1 unit of durable consumption and 1 unit of the asset

The only source of heterogeneity is in subjective probabilities.

Agents agree to disagree.

The higher the h, the more optimistic the investor.
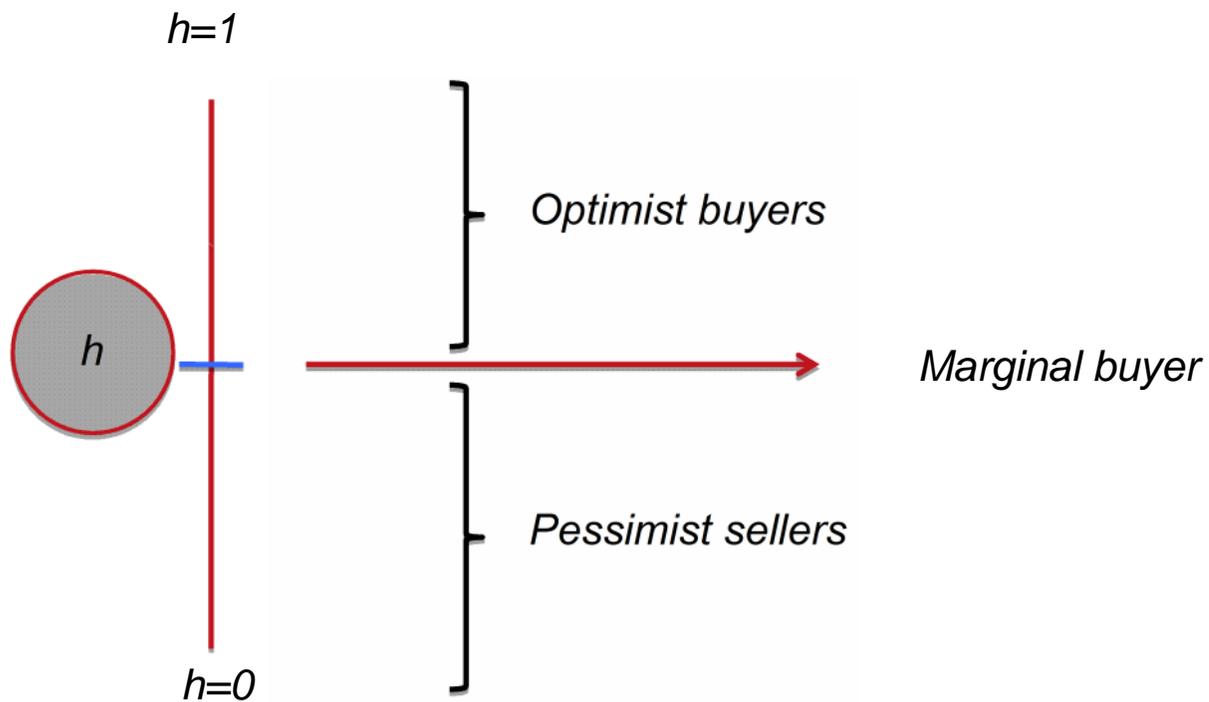
ASSET PRICES

Four Models

Non-Leverage Economy

Leverage Economy

Securitization/Tranching Economy

CDS Economy

Non-Leverage Economy

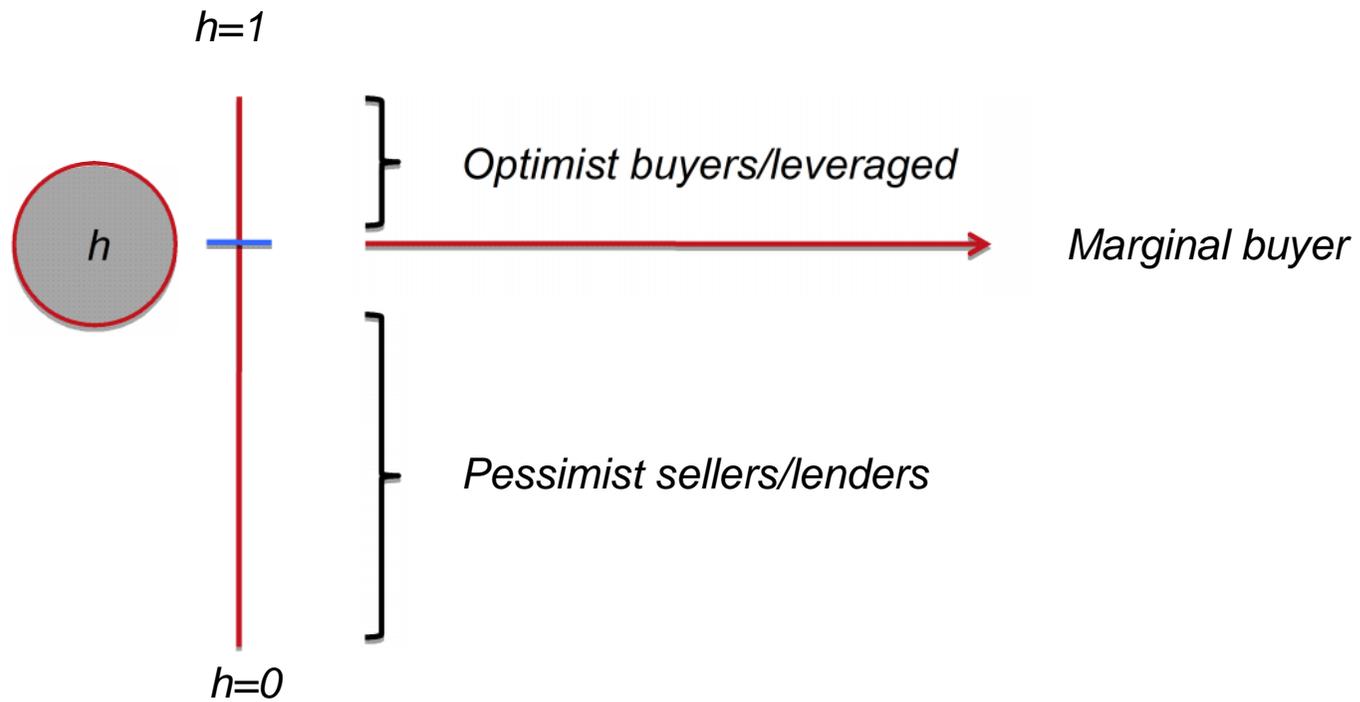*Key concept: marginal buyer of asset, h.*

Non-Leverage Equations

$$(1-h)(1+p) = p$$

$$h1 + (1-h)R = p$$

Leverage Economy

h=1

Optimist buyers/leveraged

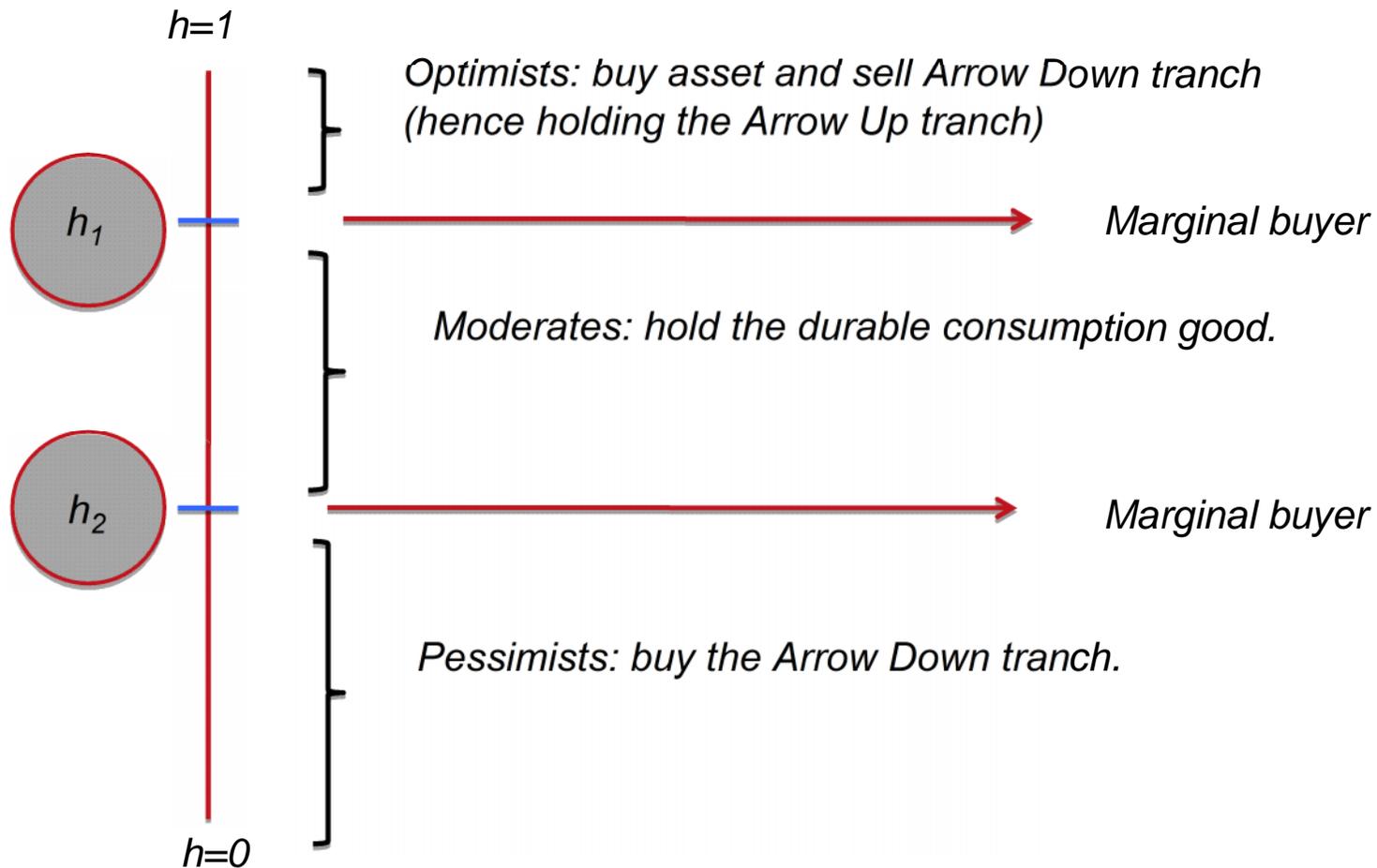Marginal buyer

Pessimist sellers/lenders

h=0

Leverage Equations

$$(1-h)(1+p) + R = p$$

$$h1 + (1- h)R = p$$

Securitization/Tranching Economy

Securitization/Tranching:

The asset is tranched into Arrow Up and Arrow Down securities.

The holder of the asset can sell off any of the tranches he likes

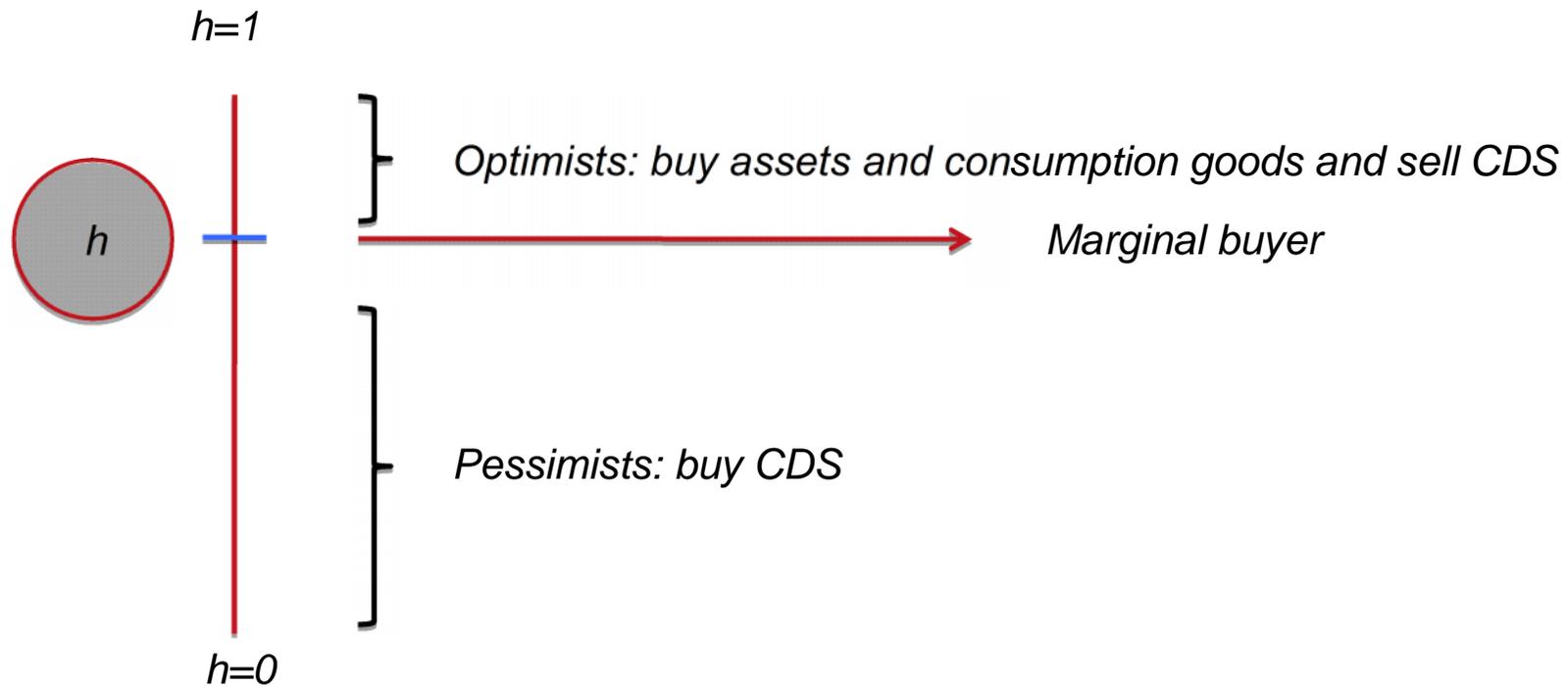and retain the rest.

Securitization/Tranching Equations

$(1-h_1)(1+p)/(p - Rp_D) = 1$

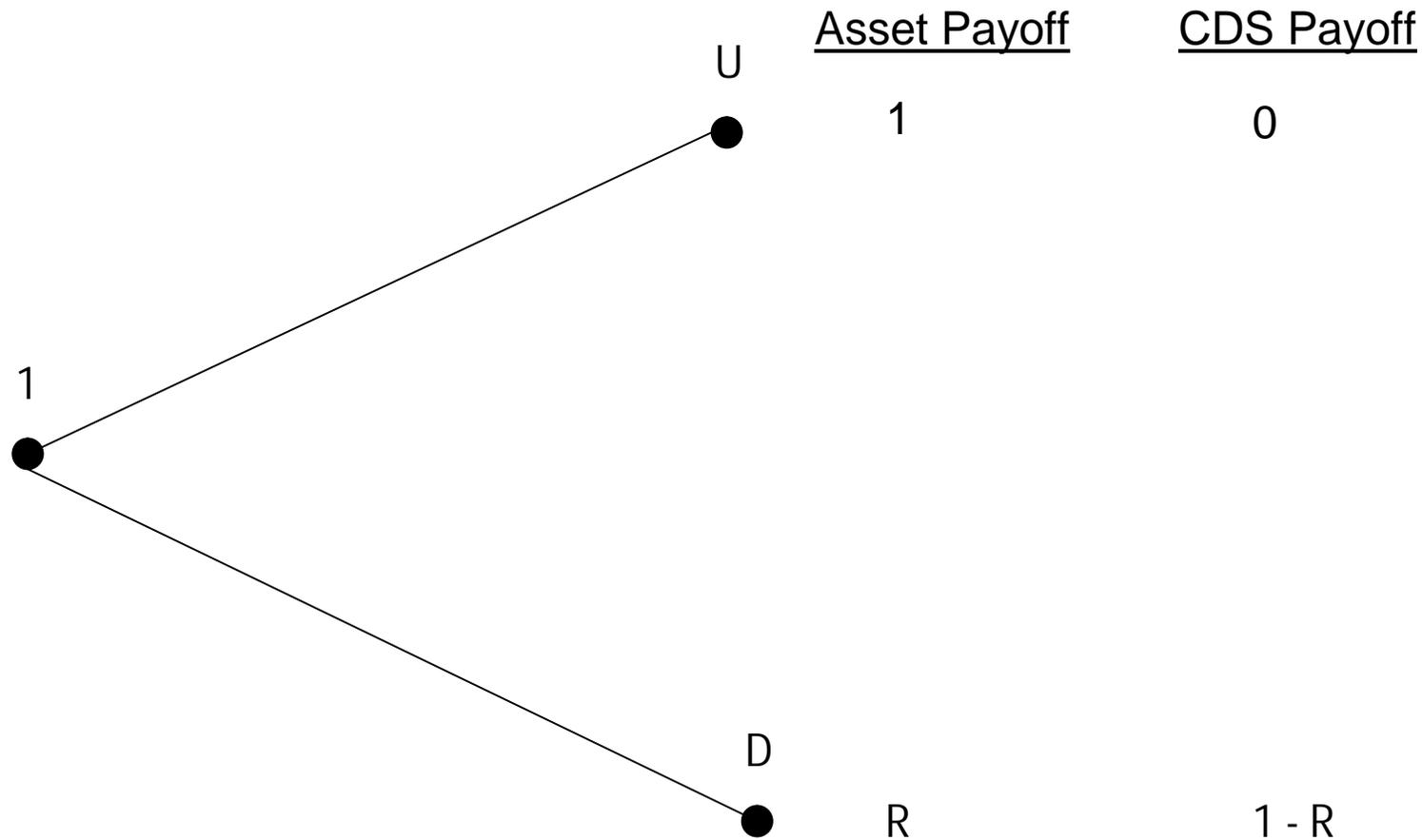$h_2(1+p)/p_D + (h_1-h_2)(1+p) = (1+R)$

$h_1/(p - Rp_D) = 1$

$h_2/p_D = 1$

CDS Economy

h=1

Optimists: buy assets and consumption goods and sell CDS

Marginal buyer

Pessimists: buy CDS

h=0

Assets and consumption goods used as collateral for CDS promises

Asset Payoff   CDS Payoff

U

1   0

1

D

R   1 - R

A seller of a CDS must post collateral either of assets or of consumption goods that are worth at least 1-R in the down state. Get Arrow-Debreu equilibrium
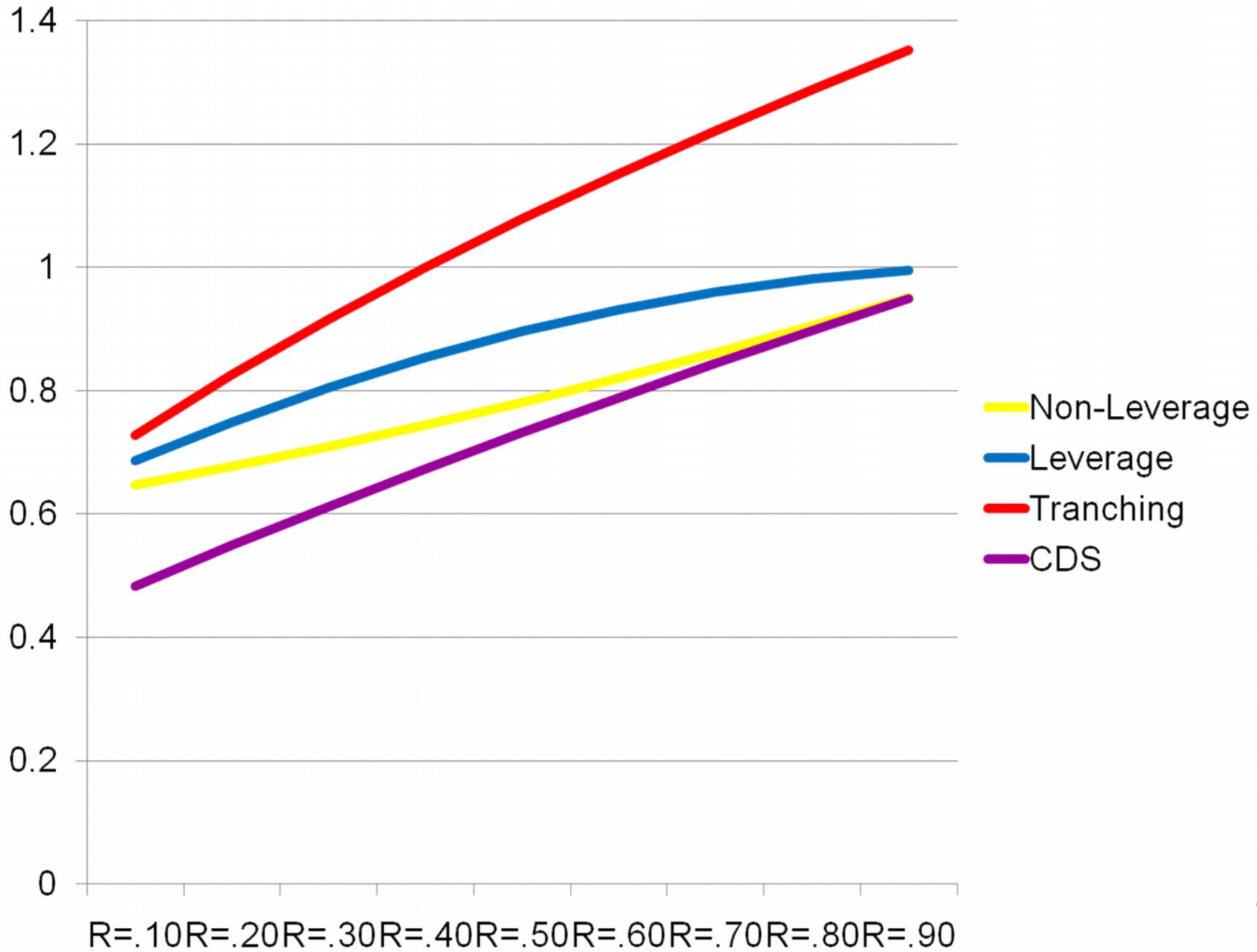
CDS Equations

$$(1-h)(1+p) + ((1+R)/(1-R))p_C = 1 + p$$

$$h1/(p-(R/(1-R))p_C) = h1/(1-(1/(1-R))p_C)$$

$$h1/(p-(R/(1-R))p_C) = (1-h)(1-R)/p_C$$

Equivalent to Arrow-Debreu equilibrium

Asset Prices

- Non-Leverage
- Leverage
- Tranching
- CDS

R=.10 R=.20 R=.30 R=.40 R=.50 R=.60 R=.70 R=.80 R=.90

108

Leverage Cycle and Derivatives

- Note that for high R, security price goes above 1 even though it never pays above 1.

- Tranching an asset raises its price relative to other assets like money. Asset acts as collateral for tranche. Even called collateral.

- Collateral for CDS is cash.

- CDS tranches cash. So raises cash price relative to assets.
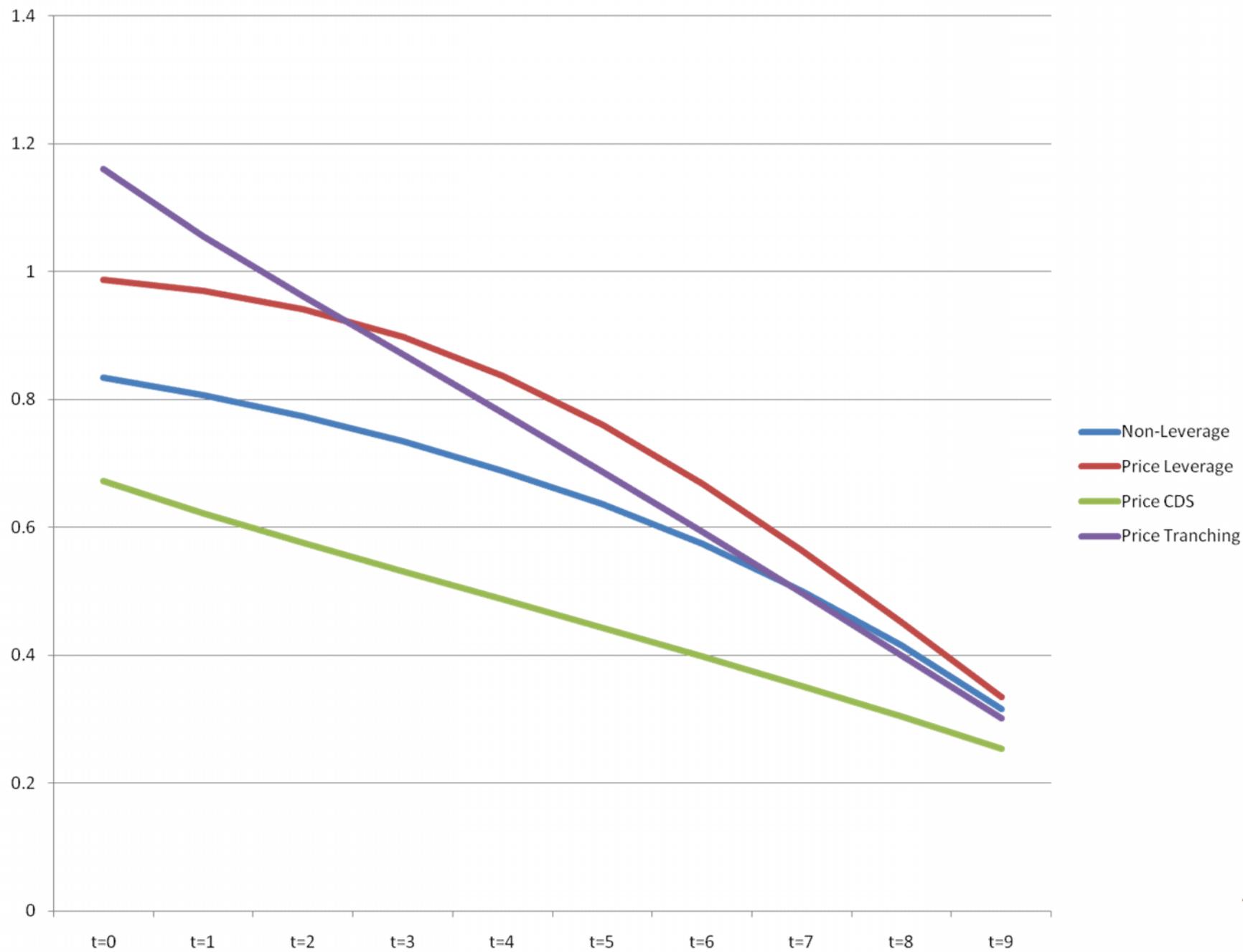
DYNAMIC ASSET PRICING

Dynamic Asset pricing

We extend the Baseline Model to a multi-period economy in which Bad News

is revealed slowly and the volatility of Bad News also increases very slowly.

Fostel-Geanakoplos (2010), called this BV economies, and showed that

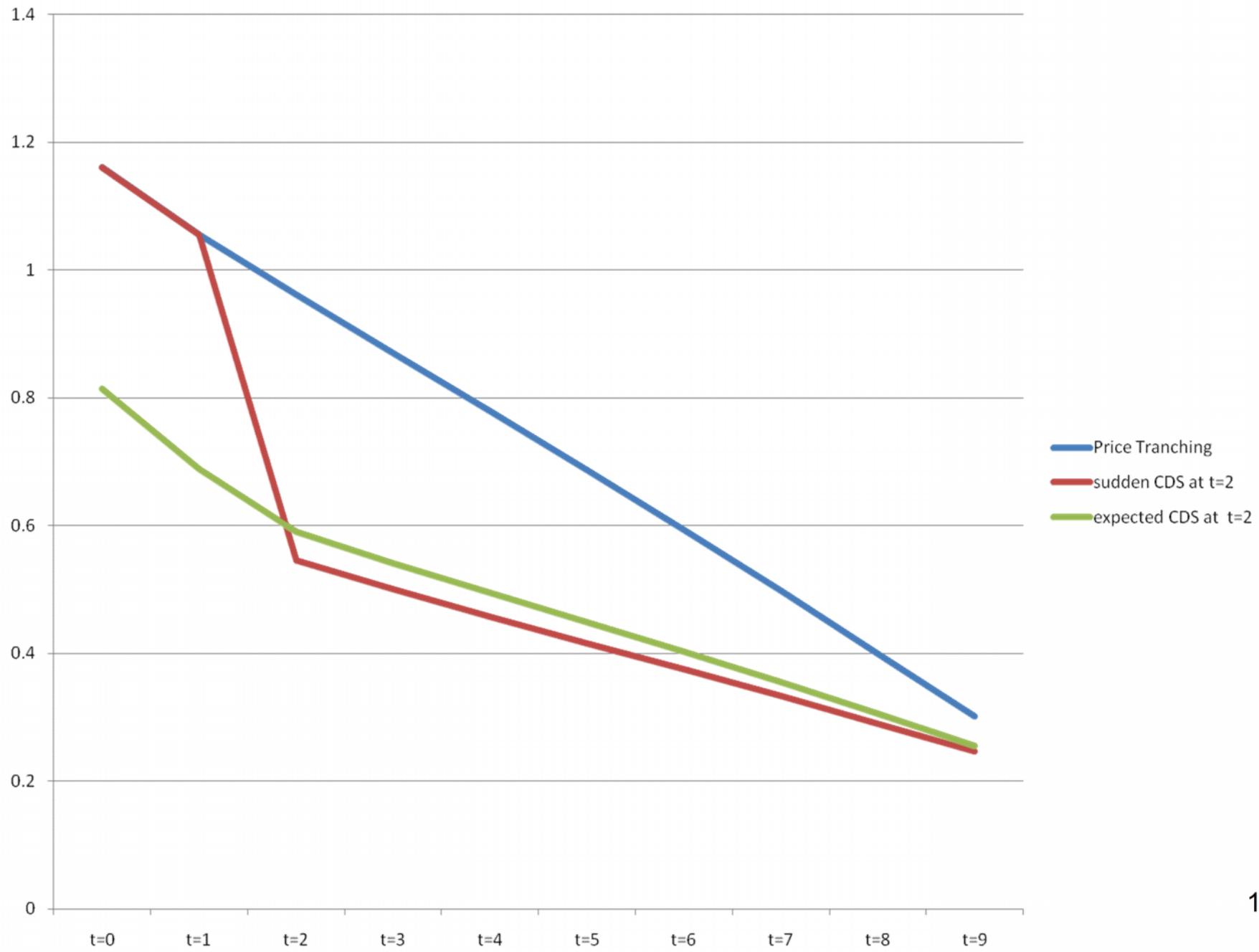agents have incentive to choose this type of assets.

Dynamic Asset pricing
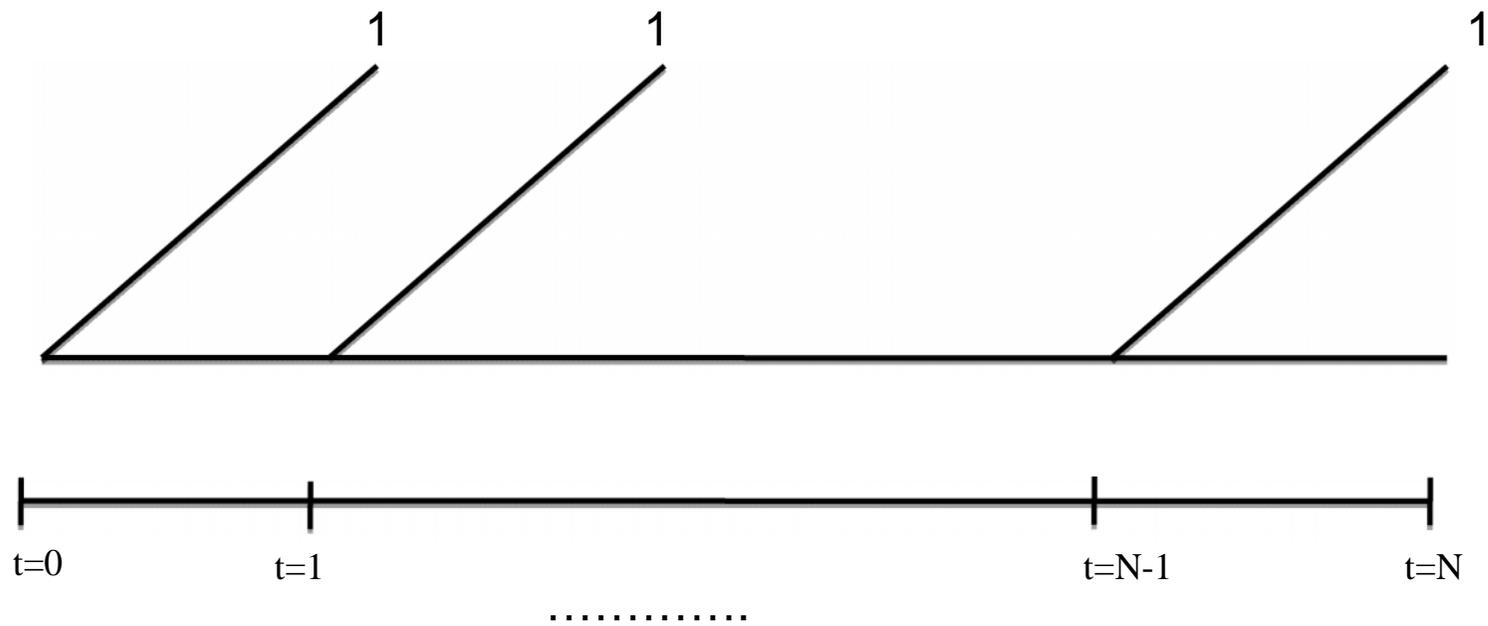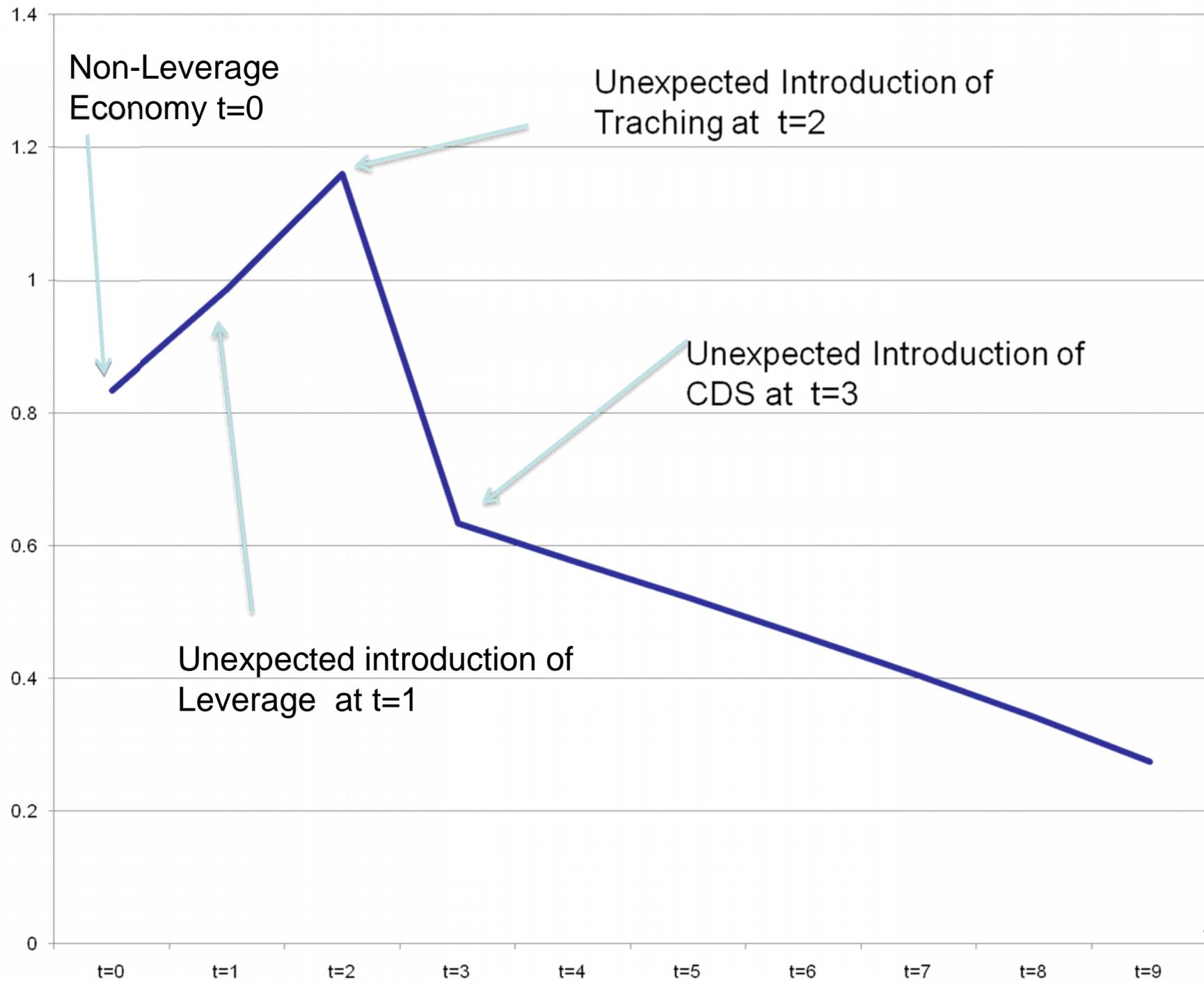
Dynamic Asset Pricing for N=10

113

Dynamic Asset prices

- Notice that leverage prices start higher and decline faster than the non-leverage and CDS prices.

- If volatility were to increase faster the leverage price would fall faster.

- The truly dramatic fall in prices will occur if CDS are unexpectedly introduced in the middle.

CDS and Crashes

115

Non-Leverage Economy t=0

Unexpected Introduction of Traching at t=2

Unexpected Introduction of CDS at t=3

Unexpected introduction of Leverage at t=1

116

Financial Innovation Bubbles and Crashes

- Timing of the Financial Innovation was most unfortunate. Securitization and Leverage created a bubble and the introduction of CDS burst it, pushing pricing faster and further down than they would have gone had there never been securitization or leverage or CDS.

- Had CDS been there from the beginning, asset prices would never have gotten so high.

- But they were not there. The volume evidence shows that they were not traded. Some people have argued that there were not incentive to trade them. But in our CDS economy, where CDS are available from the beginning the volume of trade is precisely the reverse.

End 2

ABX 06-2 Monthly Default Rate

Legend: All Loans — Never Previously Delinquent Loans
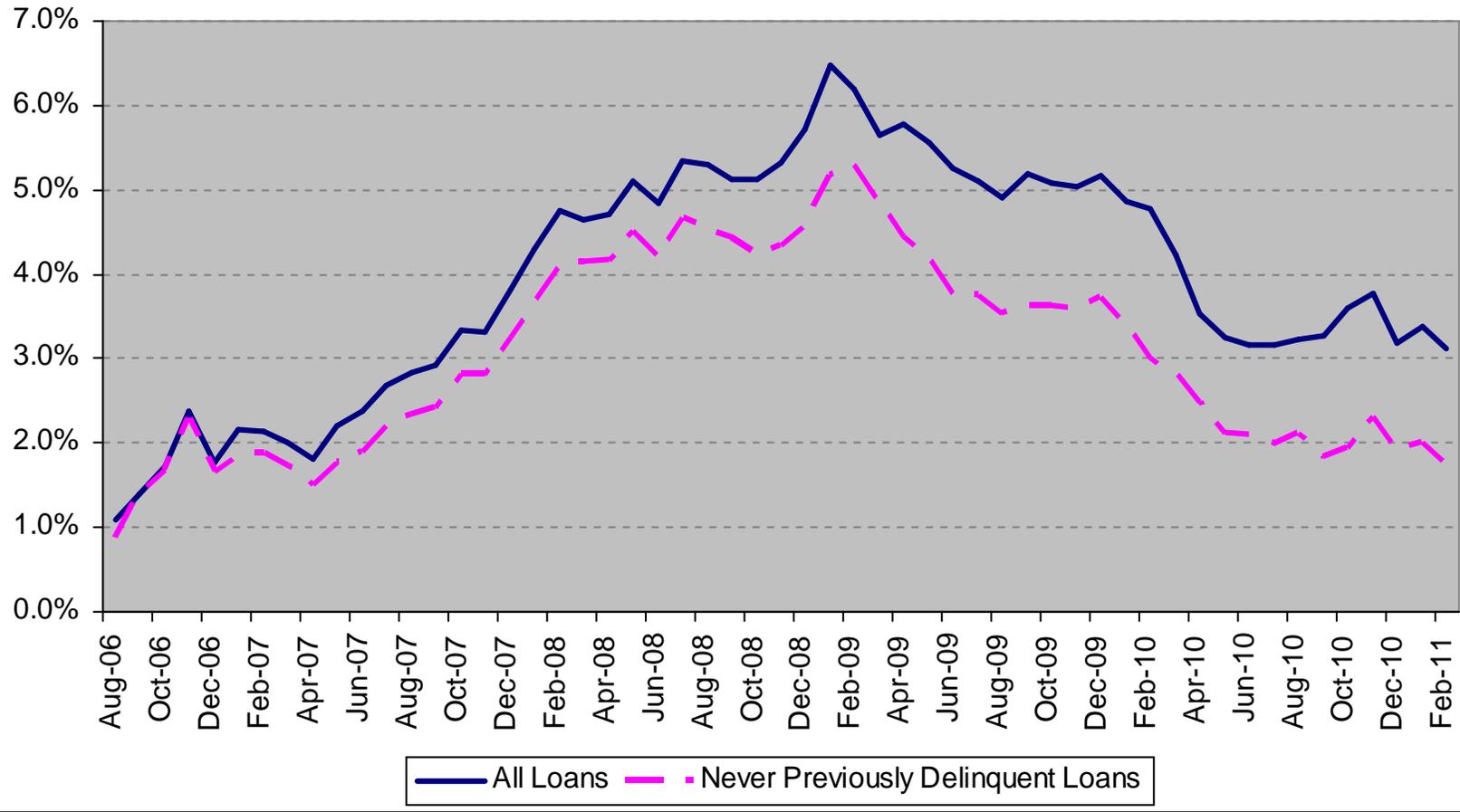
Percentages of Each Type of Modification by Investor in Third Quarter 2010

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

Re-Default Rates for Portfolio Loans and Loans Serviced for Others (60 or More Days Delinquent)*

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

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. ¹²²

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.