Tranching, CDS and Asset Prices: How Financial Innovation can Cause Bubbles and Crashes

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INTRODUCTION

We propose the possibility that the mortgage boom and bust crisis of 2007-2009 might have been caused by financial innovation.

Timing of financial innovation was crucial:

Leverage and Securitization came first raising asset prices

CDS followed much later, crushing their prices.

Many people have linked securitization and CDS to the crisis of 2007-2009.

Some problems that have been mentioned before with securitization:

i) Being able to sell collateral into a securitization destroys their incentive to choose good collateral.

ii) Once a pool is tranched it becomes very difficult for the bond holders to negotiate with each other (for example to write down principal).

Some problems that have been mentioned before with CDS:

i) Writers of insurance did not post enough collateral to cover their bets, forcing the government to bail out the beneficiaries.

ii) CDS were traded on OTC markets, with a lack of transparency that enabled price gouging.

All the problems mentioned before rely on the pernicious effect of securitization, tranching and CDS on the basic cash flows.

This paper:

We show that financial innovation affects asset prices even if they have no effect on the total cash flows.

Securitization, tranching and CDS affect asset prices because their introduction affects the Collateral Value of the asset.

We take technological innovation in the mortgage market between 1986 and 2010 as exogenous and investigate their consequences for asset prices.

I) Leverage and tranching raise the price of the underlying collateral even if they have no effect on the total cash flows coming from the collateral.

Tranching and leverage makes the asset more valuable since they raise the asset collateral value.

Leverage is an inferior tranching technology.

This creates Bubbles as in Harrison-Kreps even in a static context.

II) CDS lowers the asset price even if they have no effect on the total cash flows coming from the collateral.

When agents sell CDS using cash as collateral, they are effectively

Tranching cash!

This increases the relative price of cash to the asset.

III) In a dynamic context we show how the timing of financial innovation was crucial.

Securitization came first, raising asset prices, then CDS followed much later, crushing their prices.

GE MODEL WITH COLLATERAL

2 periods t=0,1

2 states at t=1: U and D

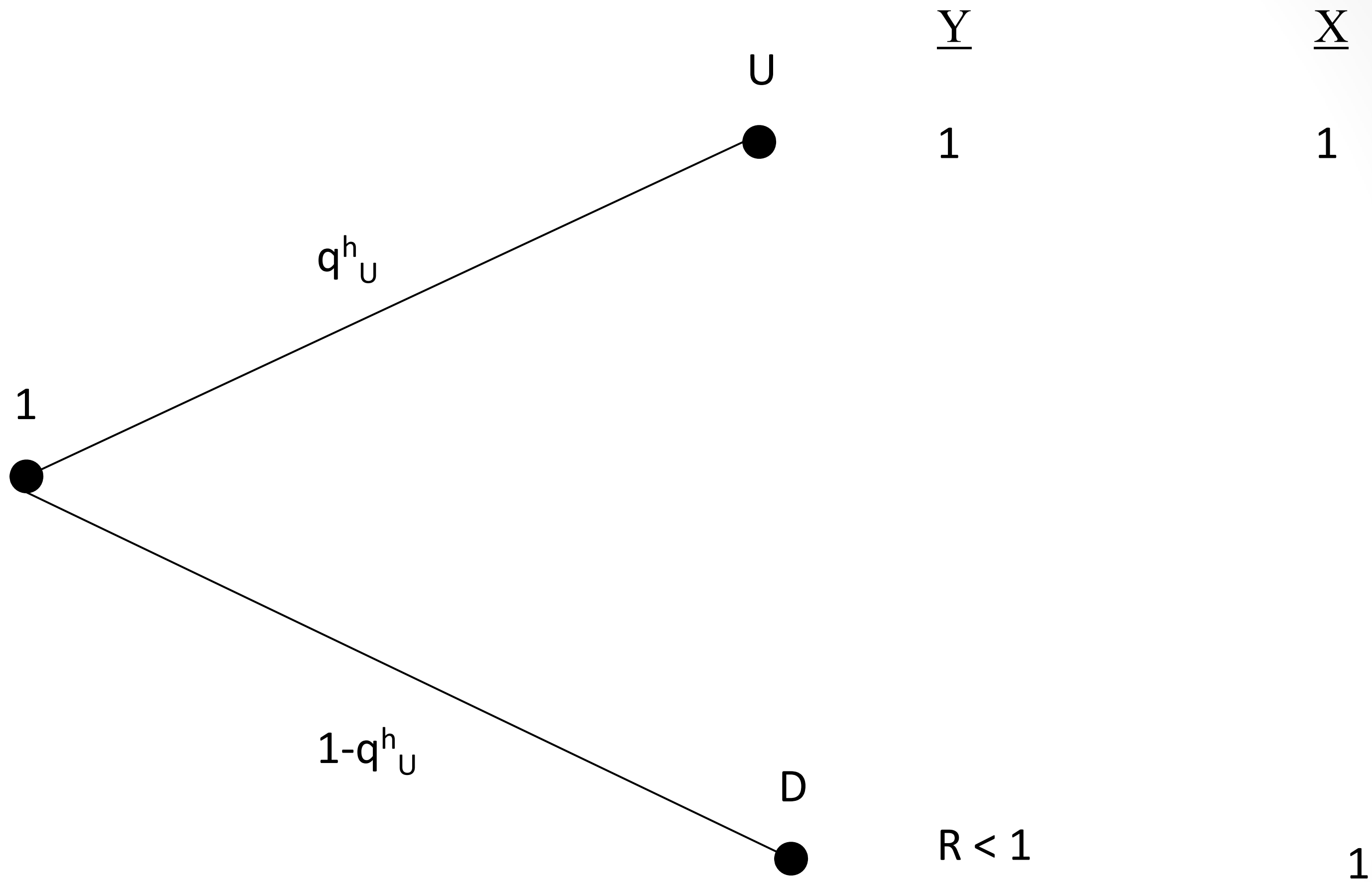
2 Assets: risky Y

riskless X

pay units of the consumption good

X is numeraire at t=0, later the consumption good.

X can be thought as a durable consumption good, cash or gold.


Y
X
U
1
1
q^h_U
1
1-q^h_U
D
R < 1
1

Continuum of agents H= [0,1]

Risk neutral. No discounting. Consumption only at the end.

$$U^h(x_U, x_D) = q^h{}_U x_U + q^h{}_D x_D$$

Endowments only at t=0:

1 unit of X and 1 unit of the asset Y

The only source of heterogeneity is in subjective probabilities.

The higher the h, the more optimistic the investor.

We assume that q^h_U is strictly increasing and continuous in h.

Important thing: heterogeneity.
Differences in risk aversion would have worked too.

Financial Contracts and Collateral:

(A, C)

$A = (A_U, A_D)$ Promise

$C \in \{X, Y\}$ Collateral backing it,

The contract delivers $(\min(A_U, C_U), \min(A_D, C_D))$

We will assume that contract can be backed by 1 unit of X or Y.

J^X The set of promises backed by 1 unit of X

J^Y The set of promises backed by 1 unit of Y

$J = J^X \cup J^Y$

Each contract j in J will trade for a price π^j

We denote the sale of a promise j by $\varphi_j > 0$ and the purchase of the same contract by $\varphi_j < 0$.

The sale of a contract corresponds to borrowing the sale price π^{j}.

Collateral Equilibrium:

$$((p,\pi),(x^h,y^h,\varphi^h,x_U^h,x_D^h)_{h\in H}) \in (R_+ \times R_+^J) \times (R_+ \times R_+ \times R^{J^X} \times \bar{R}^{J^Y} \times R_+ \times R_+)^{\ddot{H}}$$

1. $\int_0^1 x^h dh = 1$
2. $\int_0^1 y^h dh = 1$
3. $\int_0^1 \varphi_j^h dh = 0 \ \forall j \in J$
4. $(x^h,y^h,\varphi^h,x_U^h,x_D^h) \in B^h(p,\pi), \forall h$
5. $(x,y,\varphi,x_U,x_D) \in B^h(p,\pi) \Rightarrow U^h(x) \leq U^h(x^h), \forall h$

LEVERAGE, SECURITIZATION AND CDS

Four Economies

We study the effect of leverage, securitization and CDS on asset prices in 4 different economies that are characterized by different J:

1) No-Leverage Economy

2) Leverage Economy

3) Asset-Tranching Economy

4) CDS Economy

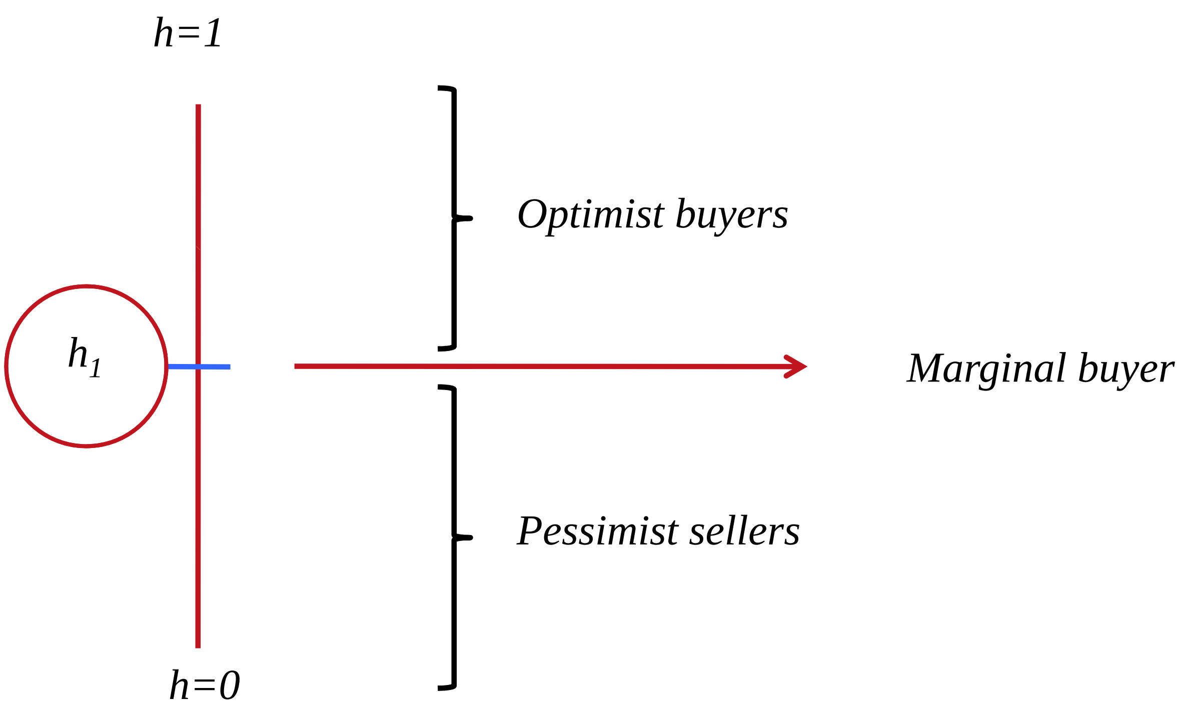
No- Leverage Economy

$$J = \emptyset.$$

Agents can only trade asset Y and X.

No borrowing, no derivatives.

No-Leverage Economy Regime



Non-Leverage Equations

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

$$p = q_U^{h_1} 1 + (1 - q_U^{h_1}) R$$

Leverage Economy

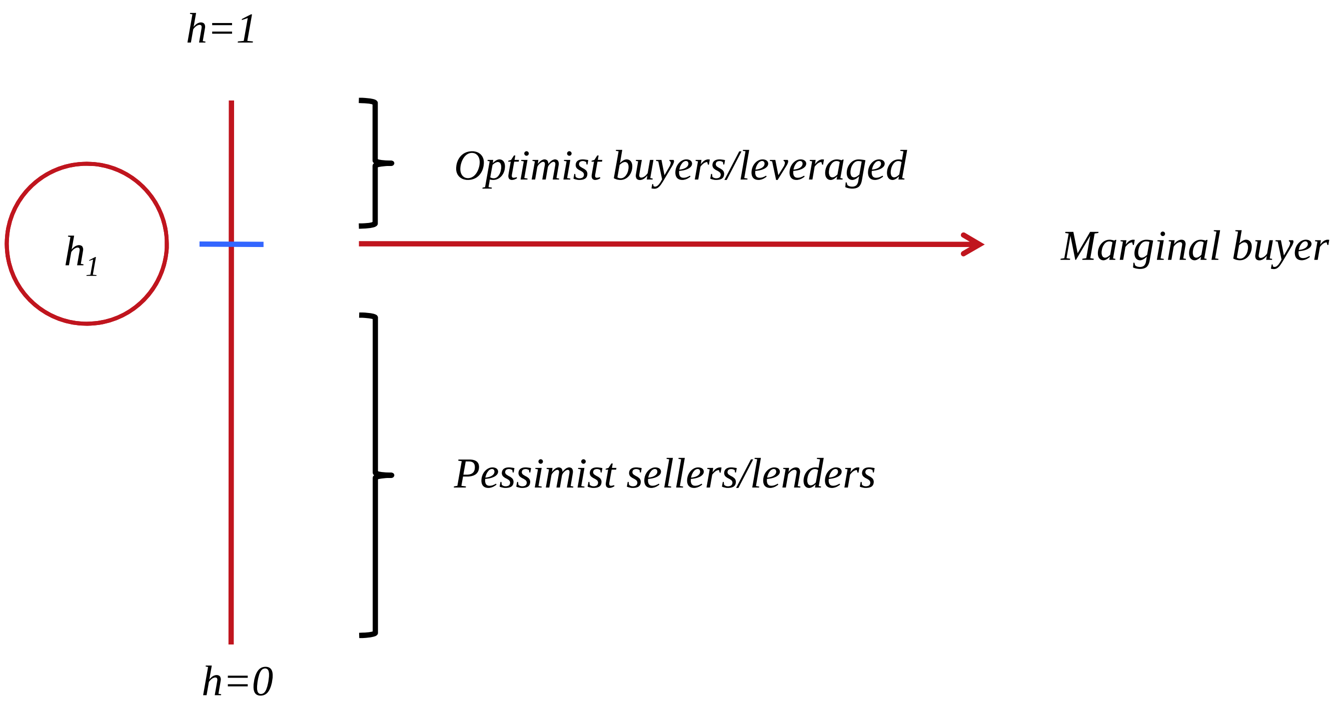
$J = J^Y$ $\qquad$ $A_j = (j, j)$ for all $j \in J = J^Y$

Proposition 1:

Suppose that in equilibrium the max min contract $j^* = min_{s=U,D}\{Y_s\} = R$ *is available to be traded, that is* $j^* \in J = J^Y$. *Then* j^* *is the only contract traded, and the risk-less interest rate is equal to zero, this is,* $\pi^{j^*} = j^* = R$.

Proof: See Geanakoplos (2003) and Fostel-Geanakoplos (2010 and 2011).

Leverage Economy Regime



Leverage Equations

$$p = (1 - h_1)(1 + p) + R$$

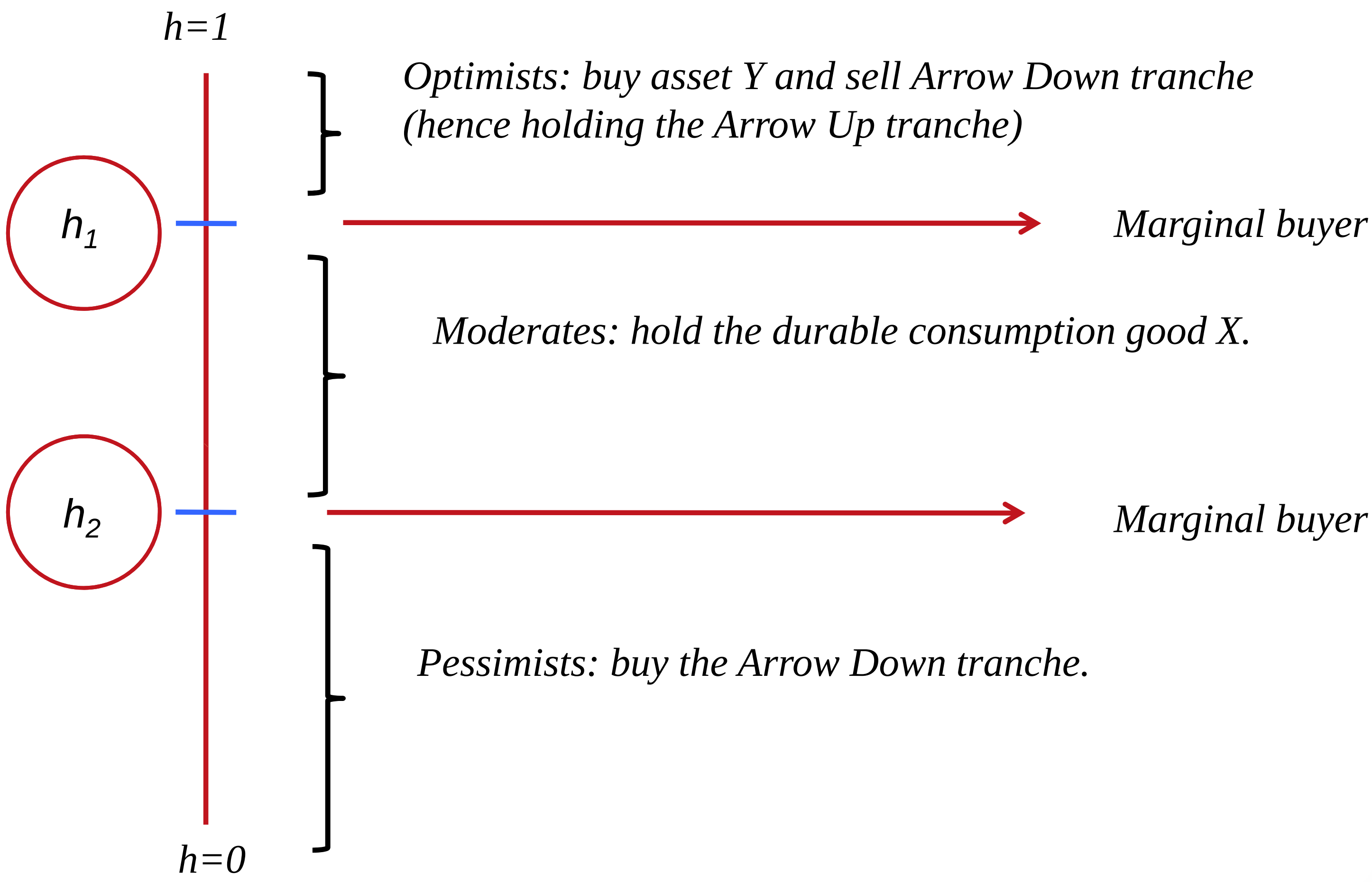
$$p = q_U^{h_1} 1 + (1 - q_U^{h_1}) R$$

Asset-Tranching Economy

The asset is tranched into Arrow U and Arrow D securities.

$$J = J^Y \qquad\qquad A = (0, R).$$

Asset-Tranching Economy Regime



Tranching Equations

$$(1 - h_1)(1 + p) + \pi_D = p$$

$$h_2(1 + p) = \pi_D$$

$$\frac{q_U^{h_1}}{p - \pi_D} = 1$$

$$\frac{(1 - q_U^{h_2})R}{\pi_D} = 1$$

2 observations:

1) Though Arrow securities are present, markets are not complete.

2) From the last two equations we have that

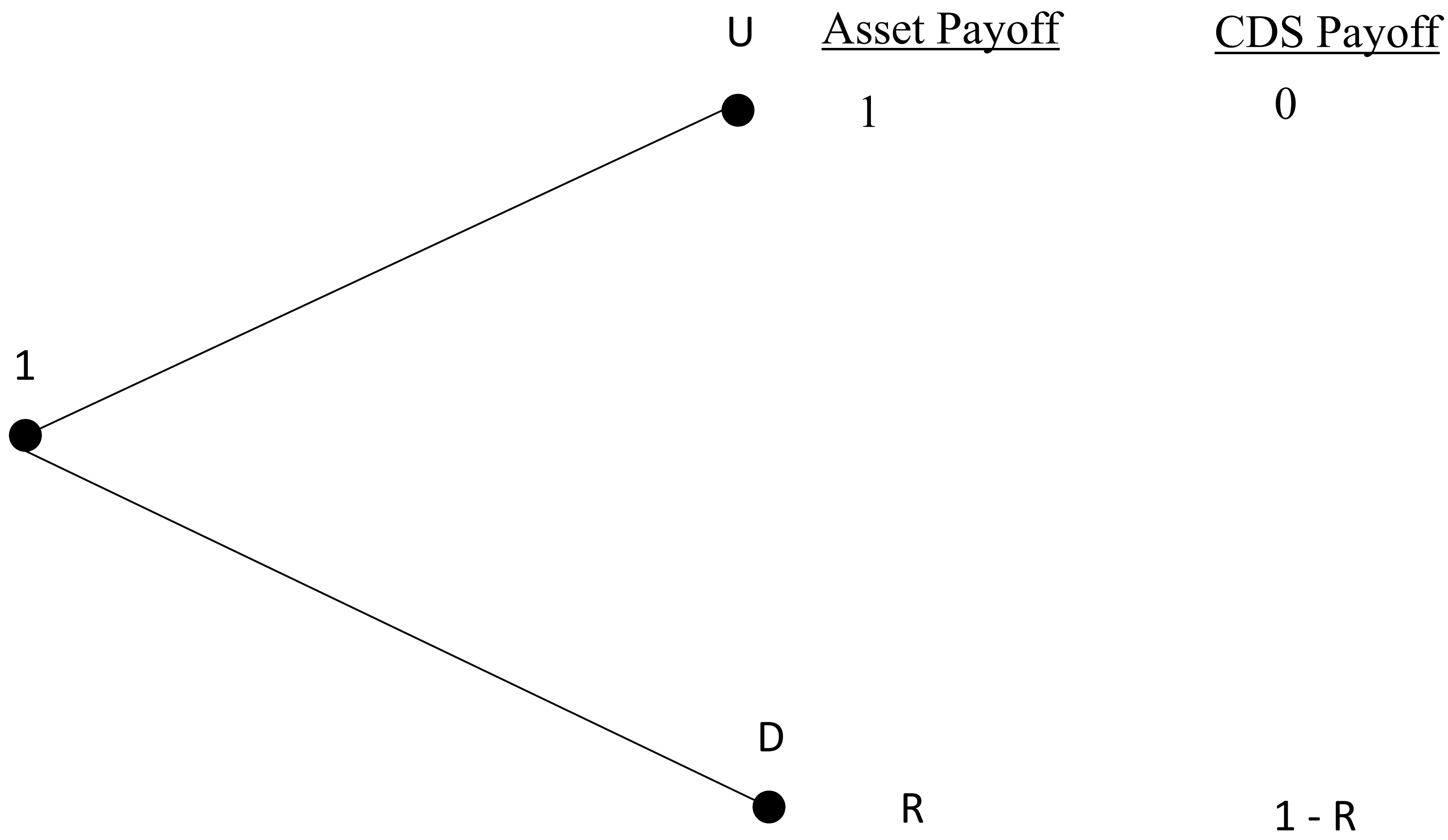
$$p = q_U^{h_1} 1 + q_D^{h_2} R$$

The asset price is determined by different marginal buyers!!

Hence, as we will see it can be higher than any agent in the economy

Thinks.

CDS Economy



A seller of a CDS must post collateral typically in the form of money that are worth at least 1-R in the down state.

Thus for every one unit of payment, one unit of X must be posted as collateral.

We can therefore incorporate CDS into our framework by taking

J^X to consists of one contract called *c* promising (0,1).

As in the previous economy, the asset Y can be tranched.

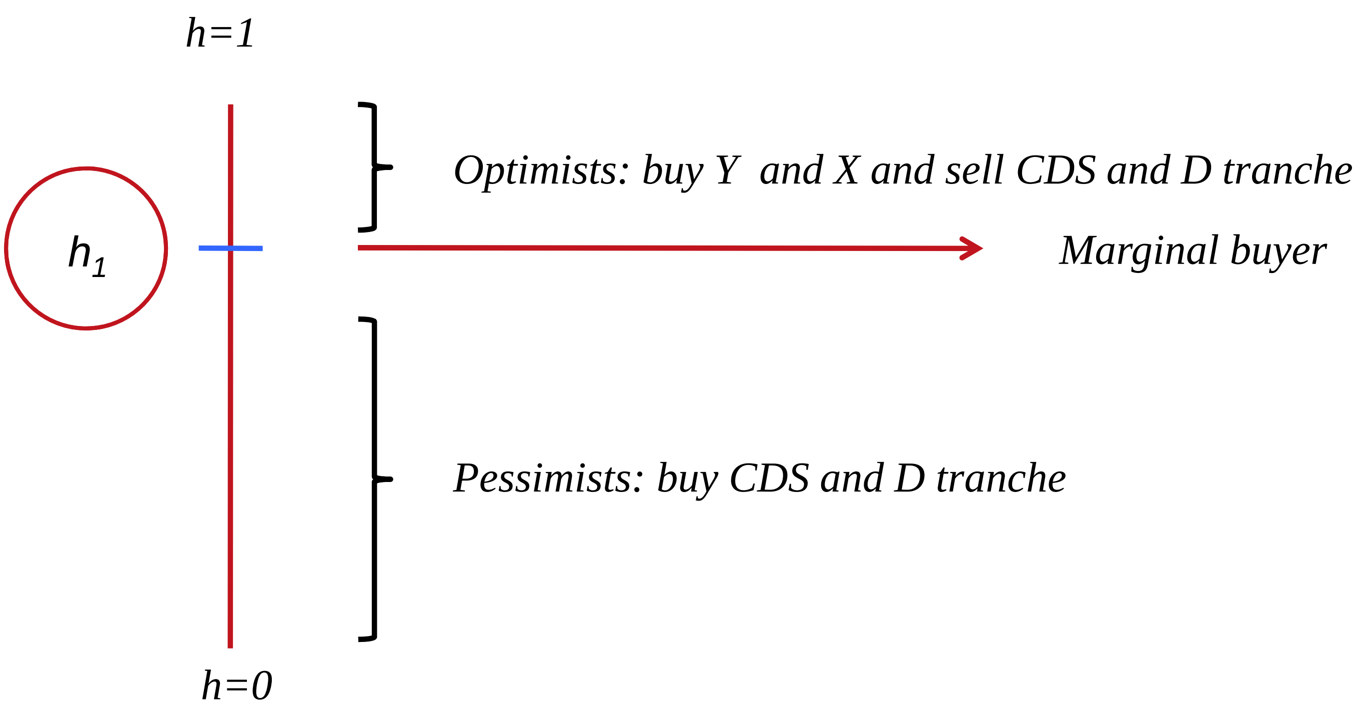
So J^Y consists of the single promise (0, R) (the Down tranche)

Of course, that is equivalent to assume that (1-R)/R units of asset Y can

be put up as collateral to back up 1 CDS promising 1-R at D.

Hence, the Arrow Down tranche and the CDS are identical securities.

CDS Economy Regime



Tranching and CDS Equations

$\pi_D = R\pi_c$

$$\frac{1}{p - \pi_D} = \frac{1}{1 - \pi_c}$$

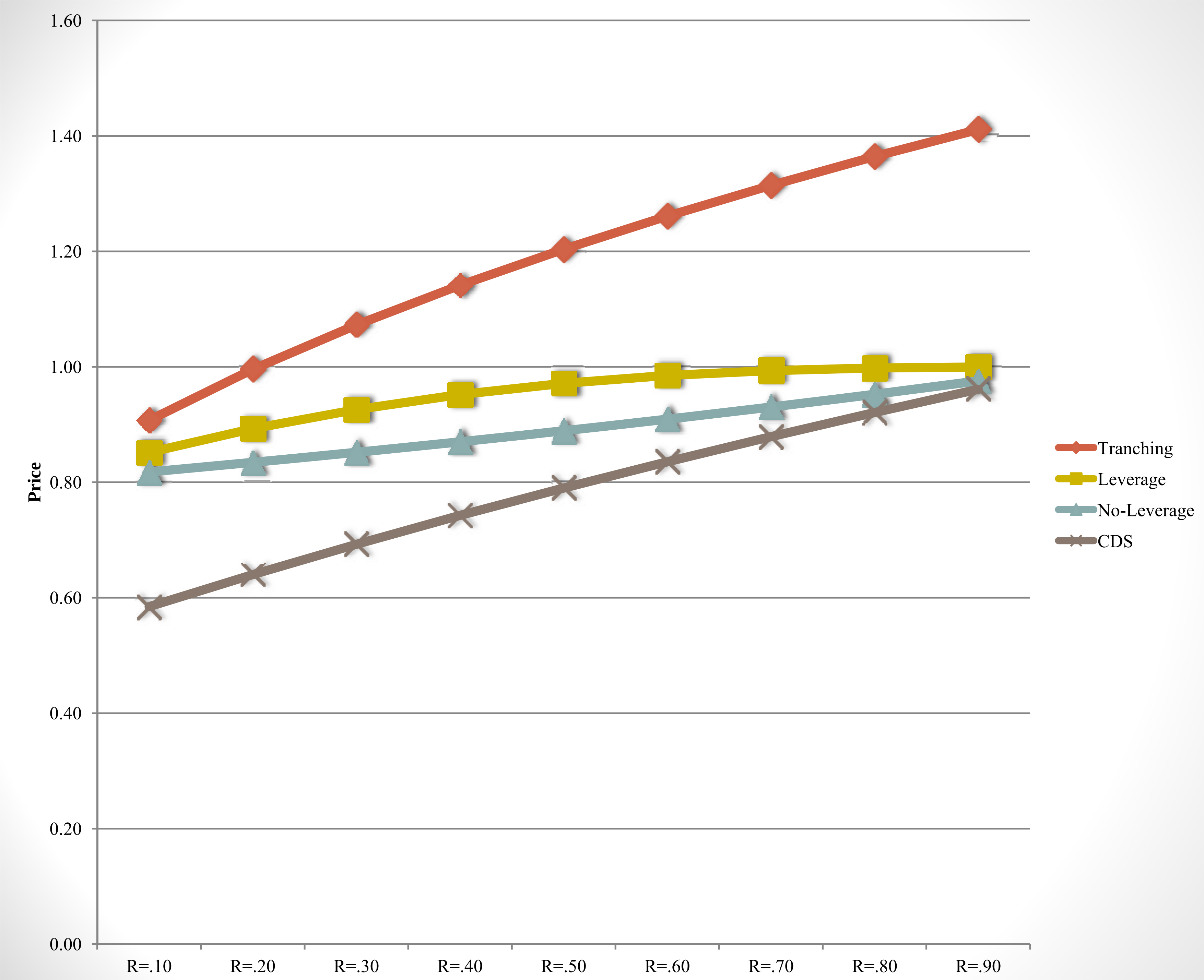
$$(1 - h_1)(1 + p) + \pi_D + \pi_c = 1 + p$$

$$\frac{q_U^{h_1}}{p - \pi_D} = \frac{(1 - q_U^{h_1})}{\pi_c}$$

This implements the Arrow-Debreu Equilibrium.

FINANCIAL INNOVATION AND ASSET PRICING

We solve for equilibrium in the four economies for $q^h_U = 1-(1-h)^2$ as R varies.


1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Price
R=.10
R=.20
R=.30
R=.40
R=.50
R=.60
R=.70
R=.80
R=.90
Tranching
Leverage
No-Leverage
CDS

1) Asset price increases as R increases and disagreement disappears for all economies.

2) CDS price < no-leverage price < leverage price < tranching price.

3) Tranching price can be higher than 1: Bubbles (Harrison Kreps)

How general is this?

Theorem: *If the* q_U^h *are strictly monotonic, concave, and continuous in* h *and if* $q_U^{1/2} \geq 1/2$, *then the Tranching asset price is greater than the Leverage asset price which is greater than the No-Leverage asset price which is greater than the CDS asset price, for all* $0 < R < 1$.

Intuition:

1) **Leverage price > no-leverage price.**

Collateral Values.

2) Tranching raises the asset price even above the leverage price.

The reason is that leverage is an imperfect tranching technology:

the asset can only be tranched into the Arrow U and the riskless bond.

With tranching the asset becomes better tranched into contingent securities.

3) Most striking the tranching price can be above 1!

More than what any agents thinks it is worth. Even if X delivers at least as much as the asset in every state.

There are tw … e was only
one. The Arr … gents, and
hence they c…

$$p = q_U^{h_1} 1 + q_D^{h_2} R$$

Bubbles as in Harrison-Kreps (78), but without dynamic hedging arguments.

Collateral Value in a static framework is enough.

4) CDS price < non-leverage price.

Puzzling!

Tranching creates exactly the same derivative payouts as CDS.

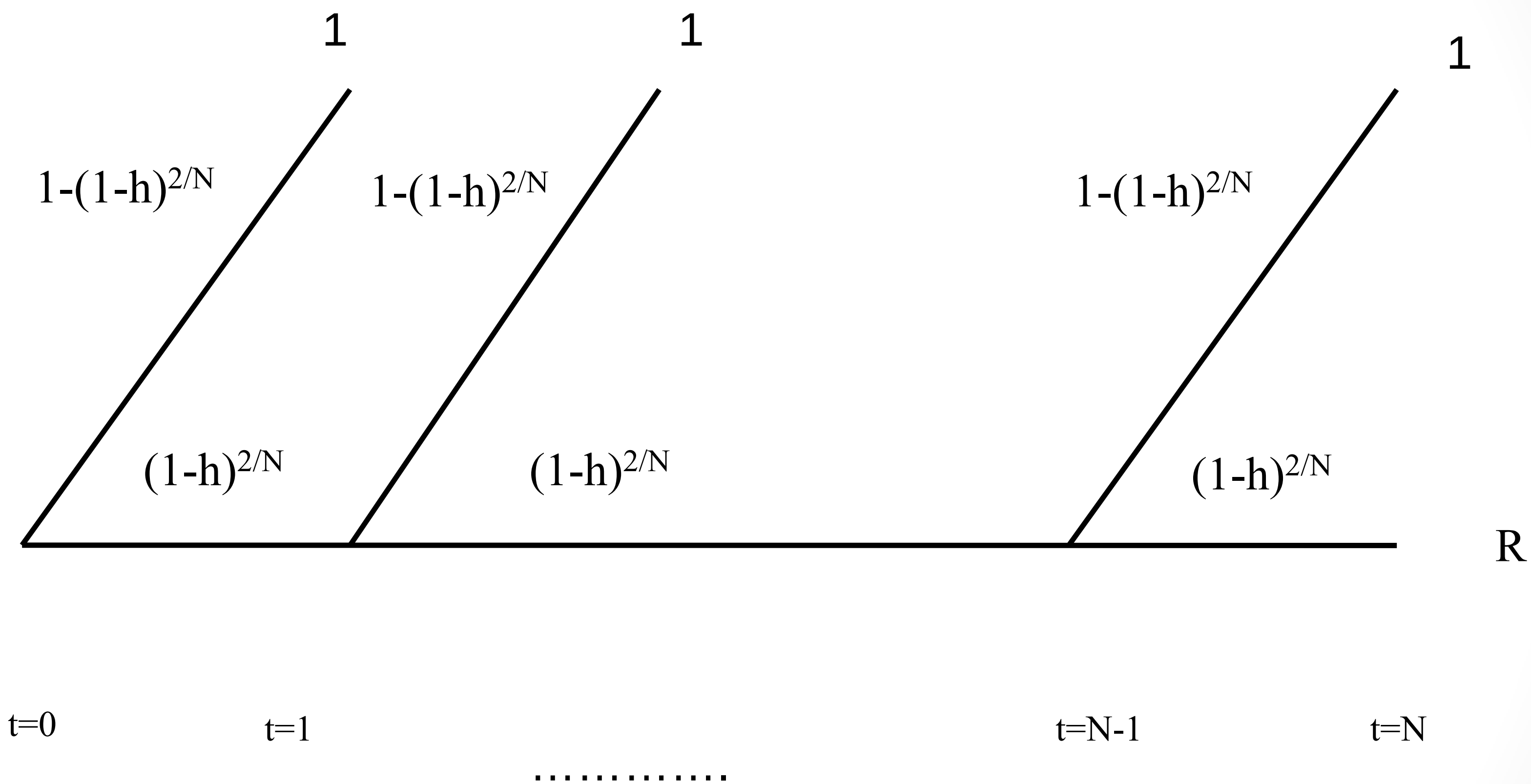
They are perfect substitutes. Yet when created inside the tranching it raises the price, when created outside, it lowers the price.

CDS on Y against X is a way of tranching cash!

That raises the collateral value of cash relative to other assets, lowering the price of Y.

DYNAMIC ASSET PRICING: BUBBLES AND CRASHES

We extend the Static 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.


1
1
1
1-(1-h)2/N
1-(1-h)2/N
1-(1-h)2/N
(1-h)2/N
(1-h)2/N
(1-h)2/N
R
t=0
t=1
t=N-1
t=N
………….

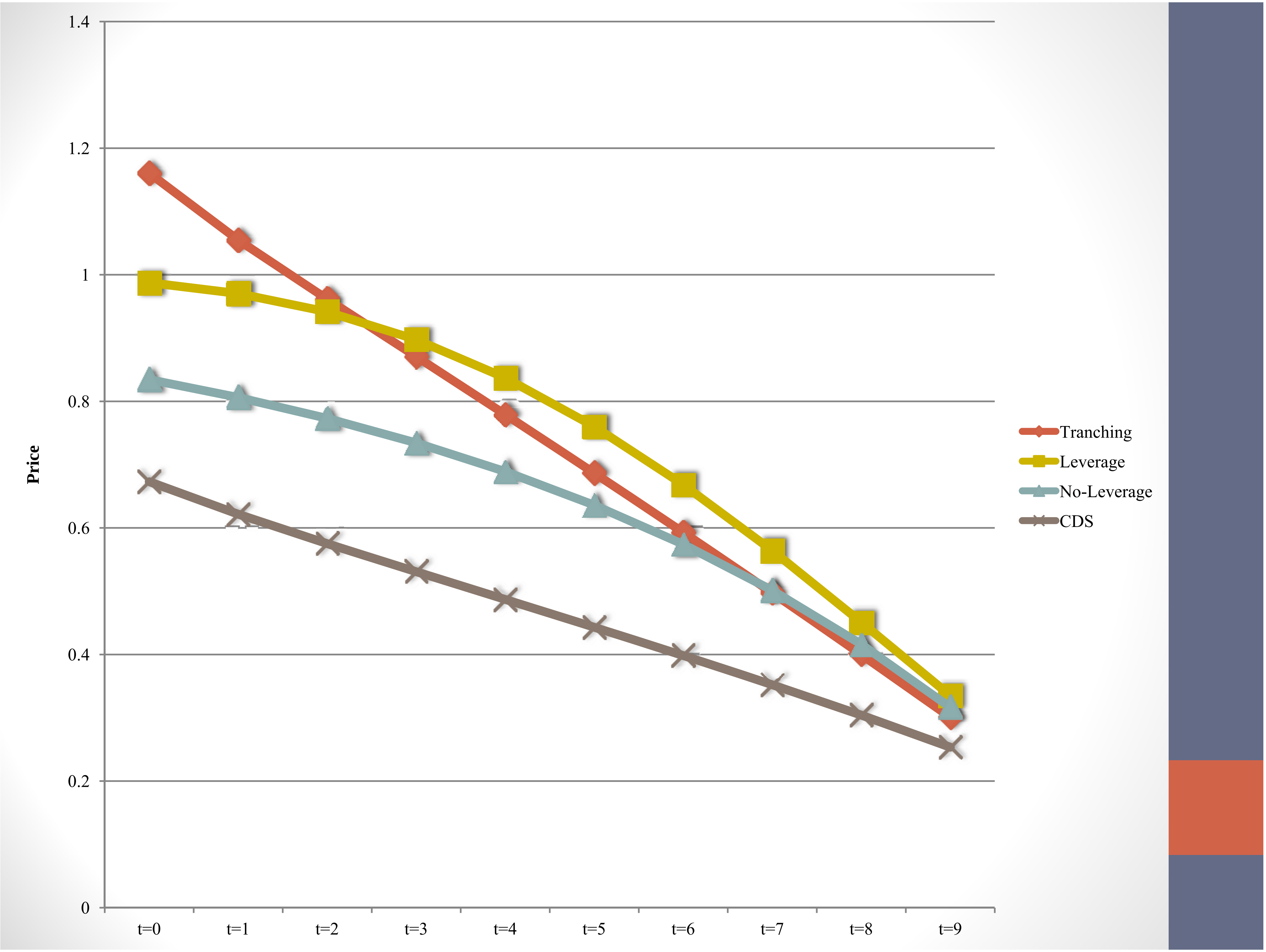
We keep the probability of final bad and good news constant equal

To $(1-h)^2$ and $1-(1-h)^2$

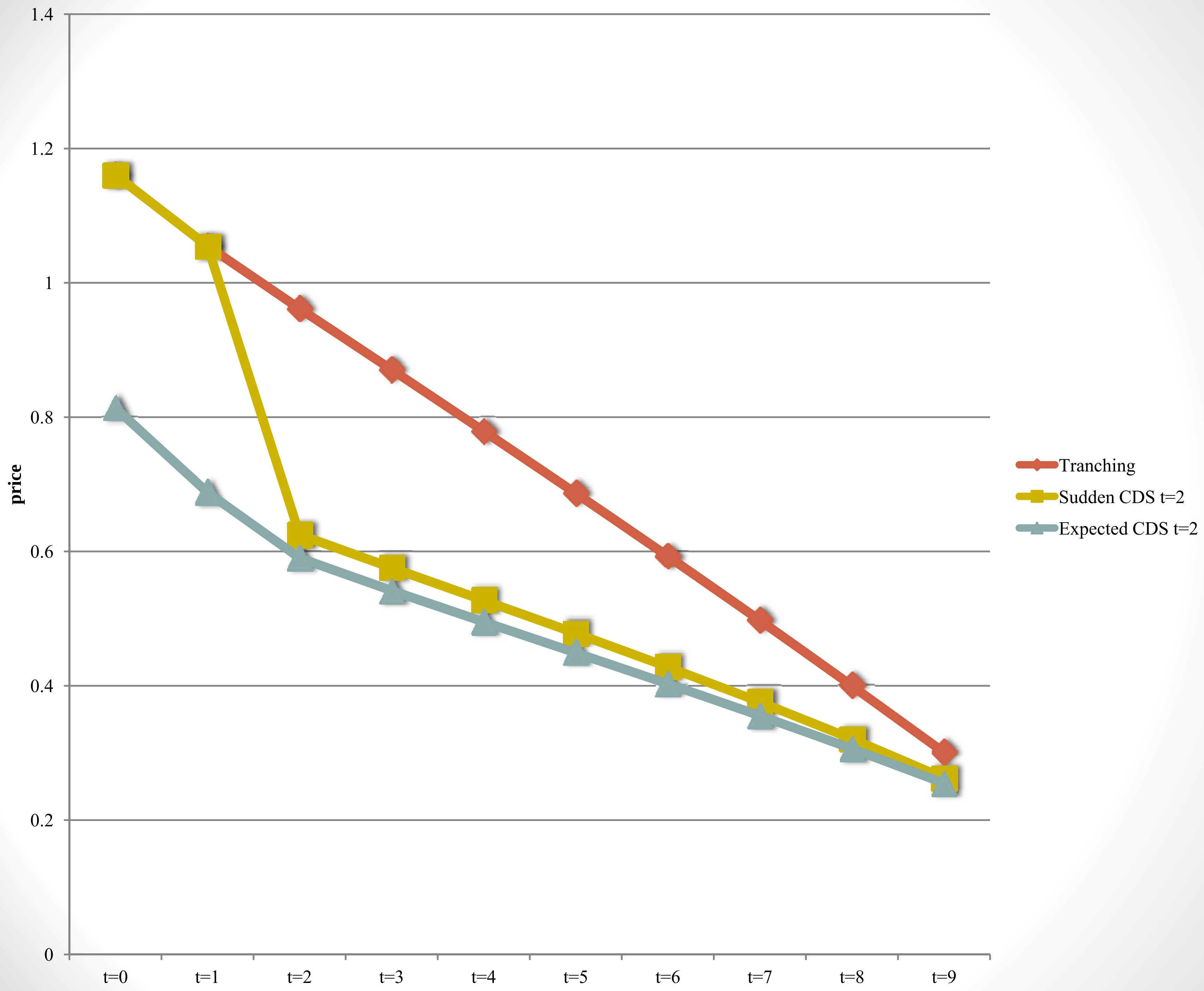
Financial contracts are defined as one period one.

So we will have J(s) for all non terminal s.

We show simulations for N=10 and R=.2



Price
1.4
1.2
1
0.8
0.6
0.4
0.2
0
t=0
t=1
t=2
t=3
t=4
t=5
t=6
t=7
t=8
t=9
Tranching
Leverage
No-Leverage
CDS



1.4
1.2
1
0.8
0.6
0.4
0.2
0
price
t=0
t=1
t=2
t=3
t=4
t=5
t=6
t=7
t=8
t=9
Tranching
Sudden CDS t=2
Expected CDS t=2

Without a CDS, there would be a drop of 17% in prices in the Tranching economy after only two pieces of bad news.

This drop is much higher, 28% even if is known since the beginning that CDS will appear at t=2.

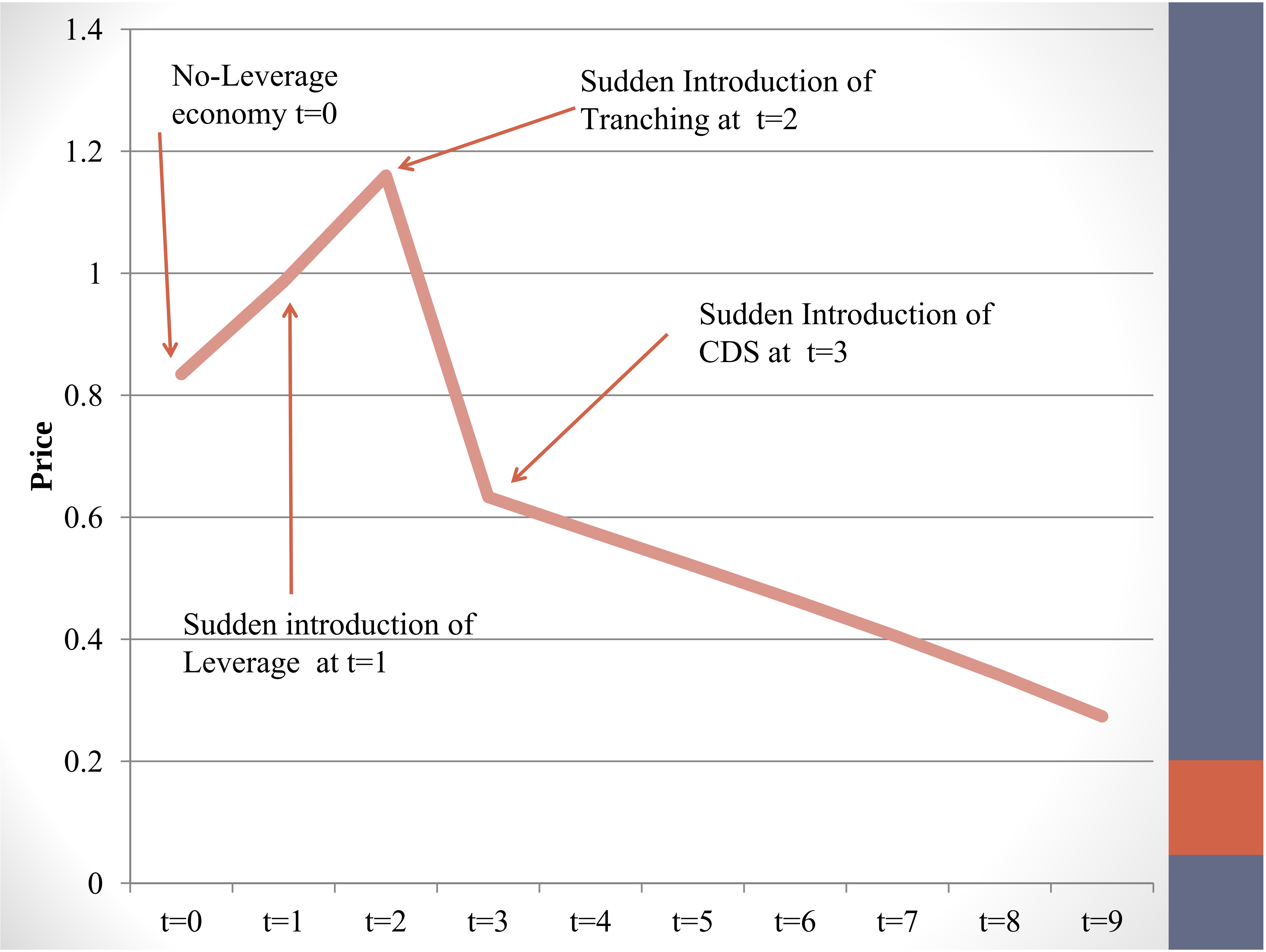
The crash becomes a horrific 46% if the CDS appear in the second period as a surprise.

Timing of the Financial Innovation was crucial.

The most dramatic drop in price occurs with the historical timing:

Leverage and Securitization first

CDS later



1.4
1.2
1
0.8
0.6
0.4
0.2
0
Price
No-Leverage economy t=0
Sudden Introduction of Tranching at t=2
Sudden Introduction of CDS at t=3
Sudden introduction of Leverage at t=1
t=0
t=1
t=2
t=3
t=4
t=5
t=6
t=7
t=8
t=9

Just one piece of bad news, on top of the introduction of CDS, reduces the price by nearly 50%!

In our dynamic model we only keep track of price after bad news, obviously in reality the leverage and tranching phases occurred mostly during pieces of good news, which made the bubble even more violent.

CONCLUSION

Financial Innovation affects asset pricing through collateral values.

Timing of the financial innovation is crucial to explain bubble and crashes.