Lecture 4: Collateral, Financial Innovation, Investment and Welfare.

John Geanakoplos (Yale)

John Hopkins, March 2015
Outline

1 Introduction
2 Facts
3 FI and Collateral
4 C and C*-Models
5 Arrow Debreu
6 Leverage
7 CDS
8 Securitization and Dynamics
9 Summary
In this lecture we will use the Collateral General Equilibrium model to think about Financial Innovation.

We will study the effect of financial innovation on prices and investment.
Outline

1 Introduction
2 Facts
3 FI and Collateral
4 C and C*-Models
5 Arrow Debreu
6 Leverage
7 CDS
8 Securitization and Dynamics
9 Summary
Summary

Financial innovation was at the center of the recent financial crisis.
Prices and Investment

**Price and Investment in Housing Sector**

Investment in new housing (thousand of units)

Case Shiller National Home Price Index

*Source Investment: Construction new privately owned housing units completed. Department of Commerce.*
Leverage and Prices

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.
The financial crisis was preceded by years in which leverage, prices and investment increased dramatically.

Then all collapsed after the crisis. Leverage Cycle.
Two Financial Innovations: Credit Default Swaps and Leverage

Source: CDS: IBS OTC Derivatives Market Statistics
Credit Default Swaps, Prices and Investments

Source CDS: IBS OTC Derivatives Market Statistics
Credit Default Swaps, Prices and Investments

CDS and Investment

Source CDS: IBS OTC Derivatives Market Statistics.
Source Investment: Construction new privately owned housing units completed. Department of Commerce.
Credit Default Swaps (CDS) was a financial innovation that was introduced much later than leverage.

Peak in CDS coincides with lower prices and investment.
We show that financial innovations that change either:

- the set of assets that can be used as collateral
- or the types of promises that can be backed with the same collateralized

affect prices and investment.

We provide precise predictions.
Collateral and Financial Innovation

In this lecture we will show that financial innovation can be cast in our general equilibrium model with collateral.

We will use the $C$ and $C^*$ models to study financial innovation.

In terms of our notation before, financial innovation we be represented by the set of financial contracts available in the economy: $J$
States and Commodities in C,C*-models

\[ S = \{0, U, D\} \).

There is a single perishable consumption good \( c \) in states \( U \) and \( D \). Agents have no endowments of these.

There are two financial assets \( X, Y \) which pay dividends only in the final period. \( X \) is riskless and pays 1 in each state, \( Y \) pays \( d_U > d_D > 0 \)

\[ L_0 = \{X, Y\}, L_U = \{c_U\}, L_D = \{c_D\} \]

\[ F_s(X, Y) = 1 + d_s Y \]
Endowments and Production in C, C*-Models

Each agent $h \in H$ has an endowment

$$(e^h_X, e^h_Y, e^h_{Uc}, e^h_{Dc}) = (x_0^*, 0, 0, 0)$$

of $x_0^*$ of asset $X$ at time 0.

Intra-period production $Z_0^h = Z_0$ in which $X$ is an input and $Y$ is an output.
Agents in C-Models

Continuum of investors \( h \in H = [0, 1] \).

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

Expected utility to agent \( h \) is

\[
U^h(c_U, c_D) = \gamma_U^h c_U + \gamma_D^h c_D
\]

The only source of heterogeneity is in subjective probabilities, \( \gamma_U^h \) is continuous and strictly increasing in \( h \). The higher is \( h \), the more optimistic the investor.
Agents in C*-Models

Arbitrary set of agents $h \in H$.

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

Expected utility to agent $h$ is

$$U^h(c_U, c_D) = \gamma^h_U u^h_U(c_U) + \gamma^h_D u^h_D(c_D)$$

But if preferences differ from C-Model, then we will assume the intra-period production set $Z_0^h$ displays constant returns to scale.
Outline

1. Introduction
2. Facts
3. FI and Collateral
4. C and C*-Models
5. Arrow Debreu
6. Leverage
7. CDS
8. Securitization and Dynamics
9. Summary
Before focusing on financial innovation, let us consider the Arrow-Debreu economy with production, without any type of collateral considerations.

This will be an important benchmark throughout the paper.
Since $Z^h_0 = Z_0, \forall h$, then $\Pi^h = \Pi$. Because of convexity, wlog we may assume that production plans are the same across agents.

Then $(z_x, z_y)$ is also the aggregate production.

Arrow Debreu equilibrium is easy to solve.
The Arrow Debreu Equilibrium in C-economies

- Optimists: buy Arrow U
- Pessimists: buy Arrow D
- Marginal buyer

$h=1$
$h=0$

$h_1$
The Arrow Debreu Equilibrium: Edgeworth Box

Intra-Period Production Possibility Frontier

$Y(d^Y_U, d^Y_D)$

$x_0^*(1,1)$

45°
The Arrow Debreu Equilibrium: Edgeworth Box
The Arrow Debreu Equilibrium: Edgeworth Box

\[ Y(d_{U}, d_{D}) \]

Intra-Period Production Possibility Frontier

Economy Total Final Output

\[ z_Y(d_{U}, d_{D}) \]

\[ x_0^*(1,1) \]

\[ z_X \]

\[ x_0^* + z_X \]

45°
The Arrow Debreu Equilibrium: Edgeworth Box

\[ Y(d_{U}, d_{D}) \]

Price line equal to Indifference curve of \( h_1 \)

Slope \(-q_{1D}^{h1}/q_{1U}^{h1}\)

\( x_0^*(1,1) \)

\( (1-h_1)Q \)

\( (1-\frac{q}{h})Q \)

Slope -q_1D/q_1U

Price line equal to Indifference curve of h_1
The Arrow Debreu Equilibrium: Edgeworth Box

\[ Y(d_{U},d_{D}) \]

Price line equal to Indifference curve of \( h_1 \)

Slope \(-q^{h_1}_D/q^{h_1}_U\)

\( x_{0^*}(1,1) \)

\( (1-h_1)Q \)

\( O \)

\( c_U \)

\( c_D \)

45°
The Arrow Debreu Equilibrium: Edgeworth Box

\[ Y(d_{U}, d_{D}) \]

Slope \(-q^{h_{1}}_{D} / q^{h_{1}}_{U}\)

Price line equal to Indifference curve of \(h_{1}\)
The Arrow Debreu Equilibrium: Edgeworth Box

- Production Possibility Frontier
- Slope \(-q^{h_1}_D/q^{h_1}_U\)
- Price line equal to Indifference curve of \(h_1\)
- Output \((d^Y_U, d^Y_D)\)
- Point \(x_0^*(1,1)\)
The Arrow Debreu Equilibrium: Edgeworth Box

Production Possibility Frontier

Slope $-q^h_1 D / q^h_1 U$

$x_0^* (1,1)$

$(1-h_1)Q$

Price line equal to Indifference curve of $h_1$

$Y(d^Y_U, d^Y_D)$

$z_y d^Y_U + x_0^* + z_x$

$45^\circ$

$z^U_c, c^D$
Optimists consume only in the $U$ state.

Pessimists consume only in the $D$ state.

The marginal buyer determines state prices.
Leverage-Economy

In the leverage economy $J = J^Y$, and each $A_j = (j,j)$ for all $j \in J = J^Y$. Assume $j = d_D \in J$

Traded instruments:

- risky asset $Y$ and cash $X$

- non-contingent promises $j$ (debt contracts or loans) using the asset $Y$ as collateral.
What does it mean to leverage $Y$?
What does it mean to leverage Y?
What does it mean to leverage $Y$?

\[
d_Y U - d_Y D
\]

\[
\text{Residual Asset } Y
\]

\[
\text{Payoff}
\]

\[
\text{Max min bond } j = j^* = d_Y^D
\]

\[
\text{45°}
\]

\[
d_Y D
\]

\[
D
\]

\[
\text{Family of debt contracts}
\]

\[
\text{Arrow } U
\]
The only contract traded in equilibrium is $j^* = (d^Y_D, d^Y_D)$.

The equilibrium regime is the following:
**L-Economy: Equilibrium in C-models**

- Optimists leverage $Y$ using max min bond. They buy Arrow $U$.
- Pessimists lenders buy max min bond.
- Marginal buyer
Numerical Example

We solve for equilibrium the Arrow Debreu and Leverage economies just described for the following:

Production: \( Z_0 = \{ z = (z_x, z_y) \in R_- \times R_+ : z_y = -kz_x \}, \ k \geq 0 \)

Beliefs: \( \gamma^h_U = 1 - (1 - h)^2 \)

Parameter values: \( x_0^* = 1, \ d^Y_U = 1, \ d^Y_D = .2. \)
Numerical Example: Investment

Investment in Y: \(-\frac{z}{x}\)

![Graph showing investment in Y as a function of \(k\).]
Numerical Example: Welfare
Theoretical Results: Over Valuation and Investment

Proposition: Over-Valuation and Investment compared to Arrow Debreu in C-Models.

In C-Models $p^L \geq p^A$, and $z^L_y \geq z^A_y$. 
Theoretical Results: Over Valuation and Investment

Proposition: Over-Valuation and Investment compared to Arrow Debreu in $C^*$-Models.

In $C^*$-Models under constant return to scale, $p_L \geq p^A$, and $z_{yL} \geq z_{yA}$. 
Theoretical Results: Welfare

**Proposition: Welfare in C*-Models**

*In C*-Models under constant return to scale, Arrow Debreu equilibrium Pareto-dominates Leverage equilibrium.*
Theoretical Results: Intuition

When $Y$ can be used as collateral, its cash flows are split into Arrow $U$ and a riskless bond.

$X$ cannot be used as collateral, hence its cash flows cannot be split.

This splitting gives $Y$ additional value (collateral value) beyond its payoff value. This gives agents more incentive to produce $Y$.

Agents are worse off over-investing.
What is a CDS?

Y Payoff
- \( d_Y^U \)

CDS Payoff
- \( d_U^Y - d_D^Y \)
A seller of a CDS must post collateral typically in the form of money that is worth $d_U^Y - d_D^Y$ when $Y$ pays only $d_D^Y$ in the down state.

We can therefore incorporate CDS into our economy by taking $J^X$ to consist of one contract called $c$ promising $A_c = (0, 1)$. 
The CDS-Economy

In this case \( J = J^X \cup J^Y \) where:

- \( J^X \) consists of the single contract called \( c \) promising \( A_c = (0, 1) \)

- \( J^Y \) consists of contracts \( A_j = (j, j) \) as described in the leverage economy.

Agents can leverage \( Y \) and also can tranche \( X \) into Arrow securities.
What does it mean to tranche X?

Selling a CDS on Y collateralized by X is like selling an Arrow D promise:

Sellers of promise $A_c = (0, 1)$ get the residual which is like the Arrow $U$ which pays 1.

We call it Tranche X because X is perfectly split into Arrow securities.
What does it mean to tranche X?

Selling a CDS on Y collateralized by X is like selling an Arrow D promise:

Sellers of promise $A_c = (0, 1)$ get the residual which is like the Arrow U which pays 1.

We call it Tranche X because X is perfectly split into Arrow securities.
What does it mean to tranche X?

Selling a CDS on Y collateralized by X is like selling an Arrow $D$ promise:

Sellers of promise $A_c = (0, 1)$ get the residual which is like the Arrow $U$ which pays 1.

We call it Tranche X because X is perfectly split into Arrow securities.
The CDS-Economy

Traded instruments:
-risky asset $Y$ and cash $X$.

-non-contingent promises (debt contracts) using the asset $Y$ as collateral.

-contingent promises (CDS) using the asset $X$ as collateral.

The equilibrium regime is as follows:
CDS-Economy: Equilibrium

- **Optimists**: buy all remaining $X$ and $Y$. Issue bond and CDS (holding the Arrow $U$)
- **Moderates**: hold the bond
- **Pessimists**: buy the CDS

Marginal buyer
Numerical Example

We solve for equilibrium in the Arrow Debreu, Leverage and CDS economies just described for the following:

Production: \( Z_0 = \{ z = (z_x, z_y) \in R_- \times R_+: z_y = -k z_x \}, \quad k \geq 0 \)

Beliefs: \( \gamma_U^h = 1 - (1 - h)^2 \)

Parameter values: \( x_0^* = 1, \quad d_U^Y = 1, \quad d_D^Y = .2. \)
Numerical Example: Investment

Investment in Y: $-z_x$

- Investment L-economy
- Investment AD
- Investment CDS-economy

$k$ values: 1, 1.1, 1.2, 1.3, 1.4, 1.45, 1.5, 1.55, 1.6, 1.65, 1.7

Investment values: 0, 0.2, 0.4, 0.6, 0.8, 1, 1.2
Numerical Example: Welfare
**Proposition: Under-Investment compared to First Best in C-Models.**

In C-Models \( p^A \geq p^{CDS} \), and \( z_y^A \geq z_y^{CDS} \) provided that \( \gamma^h_U \) is concave in \( h \).
Under Valuation and Investment

Using $X$ as collateral to sell a CDS splits its cash flows into Arrow securities.

Using $Y$ as collateral splits its cash flows into Arrow $U$ and a riskless bond.

The collateral value of $X$ is higher than the collateral value of $Y$.

This gives agents less incentive to use $X$ to produce $Y$ in the CDS economy than in Arrow Debreu.

There is no welfare domination: moderate agents in the CDS economy are better off than in the Arrow Debreu economy.
We saw that selling a CDS on $Y$ using $X$ as collateral is like selling an Arrow $D$ using $X$ as collateral.

The only difference between a CDS and an Arrow $D$ is that when $Y$ is not produced the CDS is no longer well-defined.

It is precisely this difference that can bring about interesting existence problems: introducing CDS can robustly destroy collateral equilibrium in economies with production.
Outline

1. Introduction
2. Facts
3. FI and Collateral
4. C and C*-Models
5. Arrow Debreu
6. Leverage
7. CDS
8. Securitization and Dynamics
9. Summary
We will now consider other forms of financial innovation like tranching.

We will also consider a dynamic version of the model.

We will work with the $C$-model without investment like we did in Lecture 3.
Different Economies

We study the effect of leverage, securitization and CDS on asset prices in different economies defined by different $J$:

- No-Leverage Economy.
- Leverage Economy.
- Asset-Tranching Economy.
- CDS Economy.
In this case $J = \emptyset$.

Possible trades:

-trade risky asset $Y$ and cash $X$. 
The No-Leverage Economy

- Optimist buyers of the asset
- Marginal buyer
- Pessimist sellers of the asset
The Leverage Economy

In this case $J = J^Y$, and each $A_j = (j, j)$ for all $j \in J = J^Y$.

Possible trades:

- trade risky asset $Y$ and cash $X$.

- non-contingent promises (loans) using the asset $Y$ as collateral.
The Leverage Economy
The Asset Tranching Economy

In this case $J = J^Y$ consists of the single promise $A = (0, R)$.

Possible trades:

- trade risky asset $Y$ and cash $X$.

- contingent promises (Down tranche) using the asset $Y$ as collateral.

The asset is tranched into Arrow $U$ (which is retained by the collateral holder) and the Arrow $D$ security (which is sold by the collateral holder).
The Asset Tranching Economy

Optimists: buy asset and sell Arrow Down tranche (hence holding the Arrow Up tranche)

Pessimists: buy the Arrow Down tranche.

Moderates: hold the durable good.

Marginal buyer

$h=1$

$h=0$

$h_1$

$h_2$
The Asset Tranching Economy

Two observations:

Although Arrow securities are present, markets are not complete.

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.
The Tranching + CDS Economy

As in the previous economy we still allow for tranching of the risky asset, so, \( J = J^Y \) consists of the single promise \( A = (0, R) \).

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.
The CDS Economy

- Optimists: buy Y and X and sell CDS and D tranche
- Pessimists: buy CDS and D tranche
- Marginal buyer
Numerical Simulations

- We solve for equilibrium with probabilities $q_U^h = 1 - (1 - h)^2$ in all the economies just described as $R$ varies.
Numerical Simulations
Numerical Simulations

Asset price increases as $R$ increases.

CDS price $<$ no-leverage price $<$ leverage price $<$ tranching price.

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

How general is this?
Result

Theorem:

If the $q_h^h$ 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 $0 < R < 1$. 
Leverage price is higher than No-Leverage price.

Due to the existence of Collateral Values as shown in FG (2008).
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.
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.
Financial Innovation and Asset Prices/Intuition

There are two marginal buyers now. In the leverage economy there is only one.

The Arrow securities are priced by completely different agents, and hence they can sum more than 1.

Bubbles as in Harrison-Kreps (78), but without dynamic hedging arguments. Collateral Value in a static framework is enough.
CDS price lower than non-leverage price.

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.
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 (2011), called this BV economies, and showed that agents have incentive to choose this type of assets.
Dynamic Asset Pricing: Bubbles and Crashes
Dynamic Asset Pricing: Bubbles and Crashes

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

We show simulations for \(N=10\) and \(R=.2\).
Dynamic Asset Pricing: Bubbles and Crashes

![Price vs Time Graph](image)

- **Price** along the y-axis.
- **Time** along the x-axis from **t=0** to **t=9**.
- Lines represent different scenarios:
  - **Tranching**
  - **Leverage**
  - **No-Leverage**
  - **CDS**

The graph illustrates the dynamics of asset pricing in dynamic models, showing how different factors like leverage and collateral affect price movements over time.
But as discussed ibefore, CDS were introduced much later.

We solve 2 economies:

- Tranching economy with an expected introduction of CDS at $t=2$.
- Tranching economy with a un-expected introduction of CDS at $t=2$.  

Dynamic Asset Pricing: Bubbles and Crashes
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 it 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.
Dynamic Asset Pricing: Bubbles and Crashes

No-Leverage economy at t=0

Sudden Introduction of Trading at t=2

Sudden Introduction of CDS at t=3

Sudden introduction of Leverage at t=1
Dynamic Asset Pricing: Bubbles and Crashes

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.
L-Economy: Edgeworth Box

- Intra-Period Production Possibility Frontier
- Price line equal to indifference curve of $h_1$
- $Y(d^Y_U, d^Y_D)$
- Slope $-q^{h_1}_D / q^{h_1}_U$
- $(1-h_1)Q$
- $x_0^*(1,1)$
L-Economy: Edgeworth Box

Intra-Period Production Possibility Frontier

Y(d_{d_y}^{Y_{U}},d_{d_y}^{Y_{D}})

Slope \(-q^{h_1}_{D}/q^{h_1}_{U}\)

Price line equal to indifference curve of \(h_1\)

\(x_0*(1,1)\)

\((1-h_1)Q\)
L-Economy: Edgeworth Box

Price line equal to indifference curve of $h_1$

Slope $-q^{h_1_D}/q^{h_1_U}$

Production Possibility Frontier

$Y(d^Y_U, d^Y_D)$

$(1-h_1)Q$

$x_0(1,1)$

$x_0^* + z_x$

$z_Y d^Y_D$

$z_Y (d^Y_U - d^Y_D)$

$45^\circ$

$C$
Over Valuation and Investment Geometrical Proof

Price line equal to Indifference curve of \( h_1 \)

\[
Y(d_{U}, d_{D}) \quad \text{ARROW DEBREU}
\]

\[
(1-h_1)Q \quad \text{(1-h_1)Q}
\]

\[
z_y d_{U} + x_{U} + z_x
\]

\[
x_{0^*}(1,1)
\]

\[
45°
\]

\[
0 \quad c_D
\]

\[
\text{Slope } -\frac{q_{h_1D}}{q_{h_1U}}
\]

\[
\text{LEVERAGE ECONOMY}
\]

\[
z_y d_{D}' + x_{D} + z_x
\]

\[
(1-h_1)Q
\]

\[
x_{0^*}(1,1)
\]

\[
45°
\]

\[
0 \quad c_D
\]

\[
\text{Price line equal to indifference curve of } h_1
\]
Over Valuation and Investment Geometrical Proof

Price line equal to Indifference curve of $h_1$

Slope $-\frac{q_{h1}}{u_{h1}}$

LEVERAGE ECONOMY

Price line equal to Indifference curve of $h_1$

Slope $-\frac{q_{h1}}{u_{h1}}$
Over Valuation and Investment Geometrical Proof

Price line equal to Indifference curve of $h_1$

Slope $-q_{h_1D}/q_{h_1U}$

ARROW DEBREU

LEVERAGE ECONOMY

Price line equal to Indifference curve of $h_1$
In the $L$-economy, optimists collectively consume $z^L_y (d^U_Y - d^D_Y)$ in state $U$ while in the Arrow Debreu economy they consume $z^A_y d^U_Y + (x^*_0 + z^A_x)$. The latter is evidently much bigger, at least as long as $z^A_y \geq z^L_y$.

So suppose, contrary to what we want to prove, that Arrow-Debreu output were at least as high, $z^A_y \geq z^L_y$ and $p^A \geq p^L$. 

Over Valuation and Investment Geometrical Proof
Over Valuation and Investment Geometrical Proof
Over Valuation and Investment Geometrical Proof
Over Valuation and Investment Geometrical Proof
Over Valuation and Investment Geometrical Proof
Over Valuation and Investment Geometrical Proof
Over Valuation and Investment Geometrical Proof
Over Valuation and Investment Geometrical Proof
CDS and Robust Non-Existence

The only difference between CDS and Arrow $D$ is that when $Y$ ceases to be produced the CDS is no longer well-defined.

We show how introducing CDS can robustly destroy collateral equilibrium in economies with production.
CDS and Robust Non-Existence

Suppose we introduce into the $L$-economy a CDS. We call this the $LC$-economy.

Equilibrium in the $LC$-economy equals:
- equilibrium in the $LT$-economy if $Y$ is produced.
- equilibrium in the $L$-economy if $Y$ is not produced.

Thus, if all $LT$-equilibria involve no production of $Y$ and all $L$-equilibria involve production of $Y$, then there cannot exist a $LC$-equilibrium.
CDS and Robust Non-Existence

Constant return to scale production:
\[ Z_0 = \{ z = (z_x, z_y) \in R_+ \times R_+ : z_y = -kz_x \}, \; k \geq 0. \]

Consider any \( k \in (1, 1.4) \). Rest of parameters and beliefs as before.

Then \( LC \)-equilibrium does not exist.
CDS and Robust Non-Existence

High CDS volume with low underlying Y volume

\[ Y \text{ Volume} \]
\[ CDS \text{ volume} \]

\[ L=LT=AD \]
No production for CDS

\[ LC=LT \text{ with production} \]

\[ k \]
The equilibrium in the LC economy does not exist for a robust set of parameters.