Bubbles and Debt Crises

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Outline

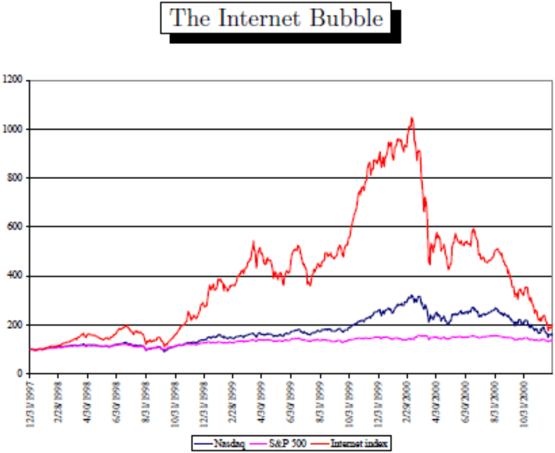
- What drives bubbles?
  - a simple framework building on short-sales constraints and heterogeneous beliefs
  - capture both asset overvaluation and trading frenzy, which are commonly observed in historical bubbles
- How are bubbles financed?
  - collateralized debt—high leverage and short maturity, joint booms in asset and credit markets
  - failure to roll over short-term debt trigers a crisis

Part I: Bubbles

- The crisis followed two great bubbles: the Internet bubble and the housing bubble.
  - The burst of the Internet bubble led to an expansionary US monetary policy for a prolonged period.
  - The low interest rate together with financial innovations such as securitization of subprime mortgages had fueled housing speculation and led to a great housing bubble.
  - The burst of the housing bubble eroded the balance sheets of many financial institutions, and eventually dragged down the world economy.

What Do We Know About Bubbles?

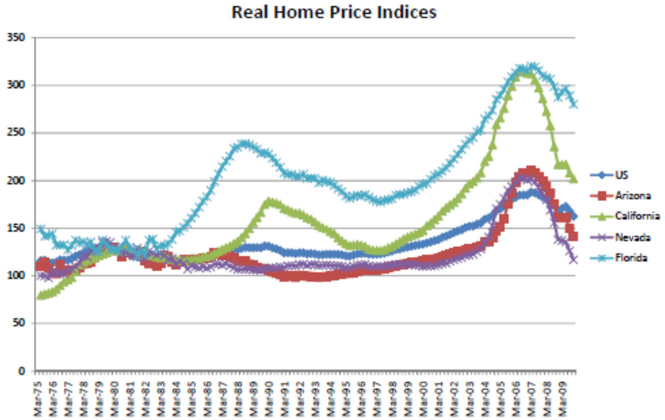
- It is common to see price bubbles in new technologies, such as railroad, radio, biotech, Internet, securitization, . . .



Some Basic Facts about the Internet Bubble

- Lamont and Thaler (2003, JPE)
  - Palm-3Com Case: Palm was valued at 20 billion dollars more than its parent company 3Com.
  - Shorting Palm stocks is difficult as it is difficult to borrow the shares.
- Ofek and Richardson (2003, JF)
  - In Feb 2000, the internet sector has roughly 400 companies, largely profitless.
  - The sector commanded about 6% of the market capitalization.
  - An astounding 20% of trading volume.
- Hong and Stein (2007, JEP)
  - A positive cross-sectional correlation for Nasdaq stocks between market-to-book ratio and trading volume.

The Housing Bubble



Some Basic Facts about the Housing Bubble

- The high flying areas such as California, Neveda, Arizona and Florida also had unusually high level of investment home purchases, as high as one third of the transactions.
- The housing boom was especially strong in subprime areas, e.g., Mian and Sufi (2009).

The Chinese Warrants Bubble

Some Basic Facts about the Chinese Warrants Bubble

- Xiong and Yu (2009)
  - 17 deeply out-of-the-money put warrants were traded nearly 300% each day at an average price of 0.48 Yuan.
  - Daily Yuan dollar can reach 45 billion Yuan ($7 billion).
- Bubble can arise even when the asset fundamentals are publicly observable.
- Bubble can arise even when the asset maturity is predetermined and finite.

The Classic Asset Pricing Theories

- Classic asset pricing theories stress that asset prices are determined by asset fundamentals, i.e., expected future cashflows and risk premium for bearing the risk.
- Capital Asset Pricing Model (CAPM) by Markowitz and Sharpe: risk premium is determined by market risk.
- No-arbitrage pricing theory by Black, Scholes, Merton, Ross: arbitrage trading by smart money would eliminate price deviation from fundamentals caused by irrational investors.
- Efficient market hypothesis by Fama: asset prices efficiently incorporate relevant information and leave no profit opportunities in the market.

A Simple Framework for Bubbles

- Two basic ingredients:
  - Short-sales constraints
  - Heterogeneous beliefs
- Key idea: asset prices are upward biased because of the short-sales constraints; time-varying beliefs lead to resale options, which further push up the prices.
- Growing literature building on this framework:
  - Miller (1977, JF), Harrison and Kreps (1978, QJE), Morris (1996, QJE), Scheinkman and Xiong (2003, JPE), Hong, Scheinkman and Xiong (2006, JF).

Short-Sales Constraints

- Shorting is difficult/illegal in many markets:
  - Houses cannot be sold short.
  - Shorting is illegal in China and various countries.
  - Shorting is allowed in US and other developed markets, but requires borrowing of the asset which can be difficult.
- Mutual funds, pension funds and insurance companies tend to restrict short-selling.
  - Broadly speaking, many institutions are reluctant to short-sell overvalued assets because of agency problems, e.g., He and Xiong "Multi-market Delegated Asset Management".
  - Payoff from shorting is negatively skewed—hard to prevent risk-seeking.

Heterogeneous Beliefs

- Heterogeneous prior beliefs
  - People tend to hold different views about new things, such as new technologies, new securities, etc.
  - Game theory models impose a common-prior assumption (Harsanyi doctrine) for convenience, rather than for economic reasons (e.g., Morris, 1995).
  - Beliefs eventually converge in the long run.
- Heterogeneous learning rules
  - Overconfidence can lead agents to overvalue their favorite signals (e.g., Scheinkman and Xiong, 2003)
  - Uncertain environment can prevent agents from agreeing on their learning models (Acemoglu, Chernozhukov, and Yildiz, 2009)

A Static Model

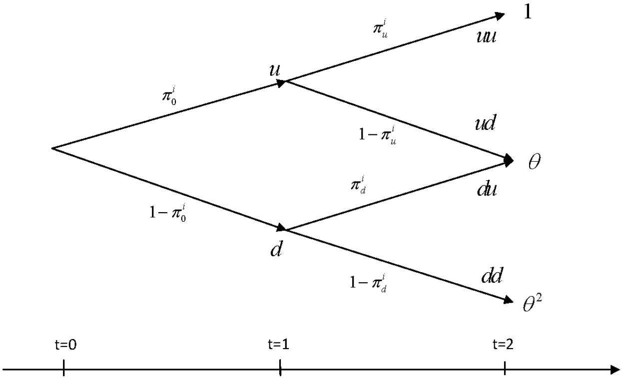
- Consider a setting with two dates: $t = 0, 1$. There is one risky asset with a random liquidation value of $\overset{\sim}{\theta}$ at $t = 1$.
  - $\overset{\sim}{\theta}$ can be 1 or 0 with probabilities of π or $1 - \pi$.
  - π is unknown to the public.
- Suppose that $\pi = 0.5$, but agents disagree about its value:
  - one group believes that its value is $\pi^h = 0.5 + \delta$;
  - the other group believes that it is $\pi^l = 0.5 - \delta$.
- Suppose that short-sales are not allowed; agents are risk-neutral; and interest rate is zero.

A Static Model (cont'd)

- What is the asset price at $t = 0$?
  - $p_0 = 0.5 + \delta$, which increases with δ.
  - The key insight of Miller (1977).
- The expected return measured by an objective econometrician:
  - $E_0\left(\widetilde{\theta}\right) - p_0 = -\delta$, which decreases with δ.
- Empirical evidence:
  - Diether, Malloy and Scherbina (2002): stocks with higher dispersion in analysts' earnings forecasts tend to have lower returns.

A Dynamic Model

- Consider a setting with three dates: $t = 0, 1$ and two groups of agents, h and l.



A Dynamic Model (cont'd)

- The objective probability of an up move is always 0.5 and $\theta = 0.4$.
  - The fundamental prices are
    - $f_u = 0.5 \times 1 + 0.5\theta = 0.7$;
    - $f_d = 0.5\theta + 0.5\theta^2 = 0.28$;
    - $f_0 = 0.5p_u + 0.5p_d = 0.49$.
- Consider a basic case: for any $n \in \{0, u, d\}$, $\pi_n^h = 0.6 > \pi_n^l = 0.4$.
  - The *h*-group determines the prices:
    - $p_u = 0.6 \times 1 + 0.4\theta = 0.76$;
    - $p_d = 0.6\theta + 0.4\theta^2 = 0.304$;
    - $p_0 = 0.6p_u + 0.4p_d = 0.5776$.

A Dynamic Model (cont'd)

- Suppose that $\pi_0^h = 0.6, \pi_0^l = 0.4$; $\pi_u^h = 0.6, \pi_u^l = 0.8$ (l-group becomes more optimistic in state u); $\pi_d^h = 0.6, \pi_d^l = 0.4$.
  - The initially more optimistic h-group has a resale optin in state u:
    - $p_u = 0.8 \times 1 + 0.2\theta = 0.88$ (by l-group);
    - $p_d = 0.6\theta + 0.4\theta^2 = 0.304$ (by h-group);
    - $p_0 = 0.6 p_u + 0.4 p_d = 0.6496 > E_0^h \left[\tilde{\theta}\right] = 0.5776$.
  - The key insight of Harrison and Kreps (1978): optimists are willing to pay a price higher than their already optimistic belief because of the resale option.

Beliefs and Learning

- Agents' beliefs on date 0 represent their priors. Each agent can update belief on date 1 based on the realized fundamental shock.
- Suppose agent i's prior has beta distribution with $\left(\alpha^i, \beta^i\right)$.
  - The mean of this distribution is $\pi_0^i \equiv \frac{\alpha^i}{\gamma^i}$ where $\gamma^i \equiv \alpha^i + \beta^i$.
  - π_0^i is mean, γ^i captures confidence.
- His posterior on date 1 also has beta distribution with confidence $\gamma^i + 1$
  - In state u, the posterior mean is $\pi_u^i = \frac{\gamma^i}{\gamma^i+1}\pi_0^i + \frac{1}{\gamma^i+1}$.
  - In state d, the posterior mean is $\pi_d^i = \frac{\gamma^i}{\gamma^i+1}\pi_0^i$.
- Even if $\pi_0^h > \pi_0^l$, the beliefs can flip on date 1 :
  - π_u^h can be lower than π_u^l if γ^h is sufficiently higher thanγ^l.
  - Then, h-agent sells his asset to l-agent for a profit.
- The flip of beliefs generates trades and motivates ex ante speculative incentives.

A Recursive Model in Continuous Time

- How is trading intensity related to price bubble?
- Scheinkman and Xiong (2003, JPE) provide a recursive model to analyze this question.
- Consider a single risky asset:

$$dD_t = f_t dt + \sigma_D dZ_t^D$$

whose drift rate is unobservable but follows

$$df_t = -\lambda(f_t - \bar{f})dt + \sigma_f dZ_t^f$$

- Two sets of risk-neutral agents, A and B. They observe D_t and two public signals generated by:

$$\begin{aligned} ds_t^A &= f_t dt + \sigma_s dZ_t^A \\ ds_t^B &= f_t dt + \sigma_s dZ_t^B \end{aligned}$$

A Recursive Model in Continuous Time (cont'd)

- Group-A agents are overconfident about their favorite signal A and believe it is generated by

$$ds_t^A = f_t dt + \sigma_s \phi dZ_t^f + \sigma_s \sqrt{1-\phi^2} dZ_t^A.$$

Group-B agents are overconfident about their favorite signal B and believe it is generated by

$$ds_t^B = f_t dt + \sigma_s \phi dZ_t^f + \sigma_s \sqrt{1-\phi^2} dZ_t^B.$$

A Recursive Model in Continuous Time (cont'd)

- In steady state, agent i's posterior

$$f_t \Big| \left\{ D_\tau, s_\tau^A, s_\tau^B \right\}_{\tau=0}^{t} \sim N\left(\hat{f}_t^i, \gamma\right)$$

with

$$\begin{aligned} d\hat{f}_t^A &= -\lambda(\hat{f}_t^A - \bar{f})dt + \frac{\phi\sigma_s\sigma_f + \gamma}{\sigma_s^2}(ds_t^A - \hat{f}_t^A dt) \\ &\quad + \frac{\gamma}{\sigma_s^2}(ds_t^B - \hat{f}_t^A dt) + \frac{\gamma}{\sigma_D^2}(dD_t - \hat{f}_t^A dt) \end{aligned}$$

and

$$\begin{aligned} d\hat{f}_t^B &= -\lambda(\hat{f}_t^B - \bar{f})dt + \frac{\gamma}{\sigma_s^2}(ds_t^A - \hat{f}_t^B dt) \\ &\quad + \frac{\phi\sigma_s\sigma_f + \gamma}{\sigma_s^2}(ds_t^B - \hat{f}_t^B dt) + \frac{\gamma}{\sigma_D^2}(dD_t - \hat{f}_t^B dt) \end{aligned}$$

A Recursive Model in Continuous Time (cont'd)

- Let g_A and g_B denote the differences in beliefs:

$$g^A = \hat{f}^B - \hat{f}^A, \; g^B = \hat{f}^A - \hat{f}^B.$$

- From group-A investors' perspective:

$$dg_t^A = -\rho g_t^A dt + \sigma_g dW_t^{A,g},$$

where

$$\begin{aligned} \rho &= \sqrt{\left(\lambda + \phi \frac{\sigma_f}{\sigma_s}\right)^2 + (1-\phi^2)\sigma_f^2 \left(\frac{2}{\sigma_s^2} + \frac{1}{\sigma_D^2}\right)}, \\ \sigma_g &= \sqrt{2}\phi\sigma_f, \end{aligned}$$

and $W^{A,g}$ is a standard Wiener process.

- Similarly, for agents in group B, g^B satisfies:

$$dg_t^B = -\rho g_t^B dt + \sigma_g dW_t^{B,g},$$

where $W^{B,g}$ is a standard Wiener process.

A Recursive Model in Continuous Time (cont'd)

- Assume that both groups A and B are large, no short selling, and risk-free borrowing available at rate r.
- Let $o \in \{A, B\}$ denote the current owner, $\bar{o}$ the other group. Then,

$$p_t^o = \sup_{\tau \geq 0} E_t^o \left[\int_t^{t+\tau} \mathrm{e}^{-r(s-t)} dD_s + \mathrm{e}^{-r\tau} (p_{t+\tau}^{\bar{o}} - c) \right],$$

  where τ is a stopping time, c is a transaction cost charged to the seller, and $p_{t+\tau}^{\bar{o}}$ is the reservation value of the buyer at $t + \tau$.
- A conjecture of the price function

$$p_t^o = p^o(\hat{f}_t^o, g_t^o) = \frac{\bar{f}}{r} + \frac{\hat{f}_t^o - \bar{f}}{r + \lambda} + q(g_t^o),$$

  with $q > 0$ and $q' > 0$.
- The resale option value satisfies

$$q(g_t^o) = \sup_{\tau \geq 0} E_t^o \left[\left(\frac{g_{t+\tau}^o}{r + \lambda} + q(g_{t+\tau}^{\bar{o}}) - c \right) \mathrm{e}^{-r\tau} \right].$$

- Trading occurs for the first time that g^o hits a threshold k^*.

Effects of Overconfidence

- Higher overconfidence ⇒more volatile disagreement⇒more trading & bigger bubble

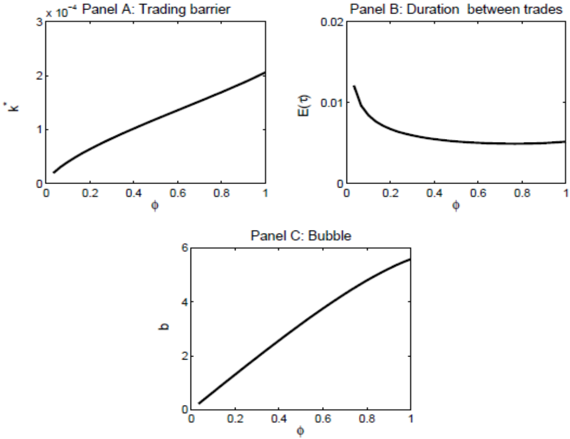


Figure 1: Effect of overconfidence

Effects of Information

- More information can lead to more disagreement, and thus more trading & bigger bubble.

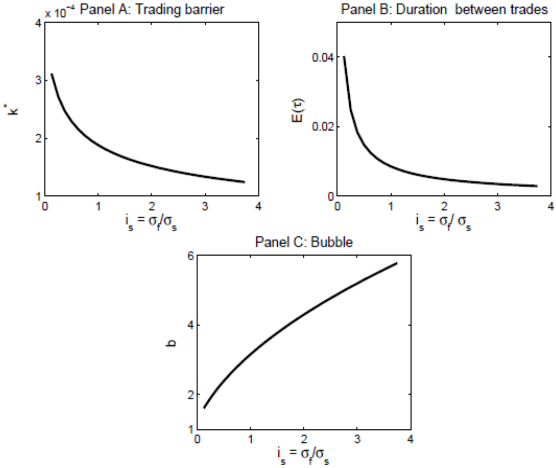


Figure 2: Effect of information

Effects of Trading Cost

- Tobin's tax can greatly reduce trading, but has only a second-order effect on price bubble.

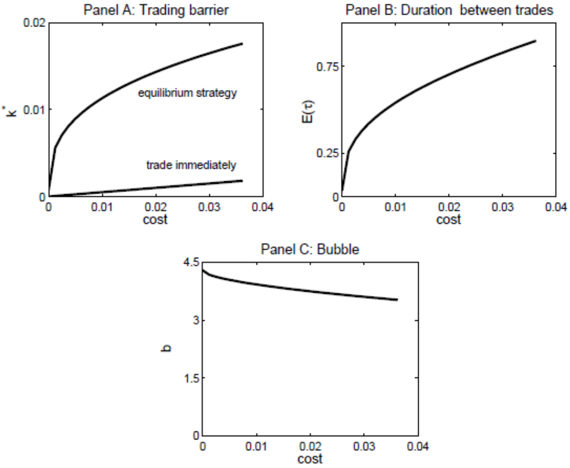


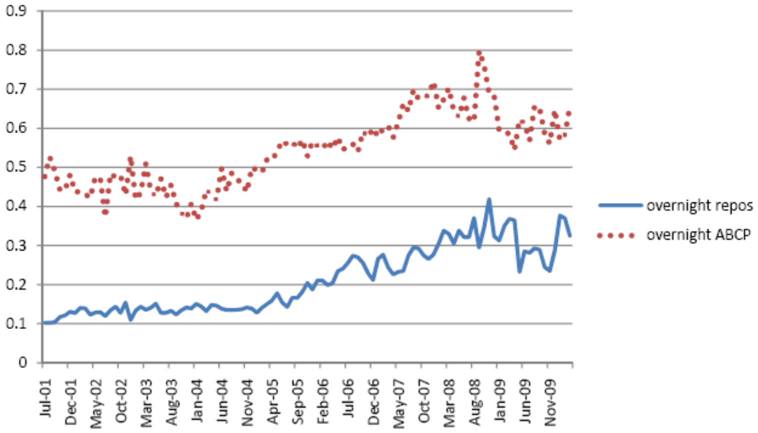
Figure 3: Effect of transaction cost

Part II: Financing Bubbles and Debt Crises

- Leverages and debt structure emerged at the center of the recent financial crisis:
  - Financial institutions used large leverages.
  - Debt maturity dramatically shortened before 2007.
  - Failure to roll over short-term debt triggered the crisis and systemic liquidity risk.
- How do optimists finance their speculation if they don't have enough cash?
  - Geanakoplos (2009): collaterized debt
- Focus on a model by A model by He and Xiong (2010) on "Heterogeneous Beliefs and Short-term Credit Booms".
  - Joint choices of leverage and debt maturity

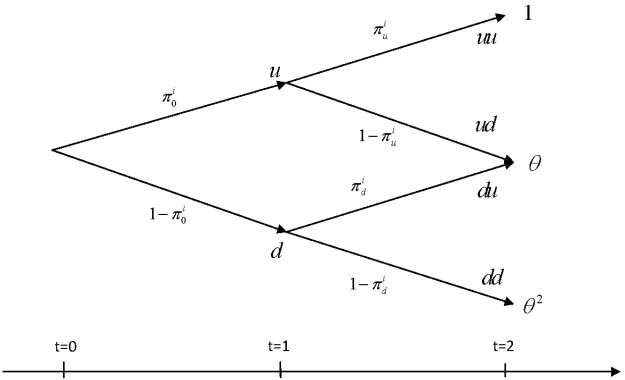
Maturity Shortening Before the Crisis

- Fraction of monthly issuance of overnight repos and ABCP



The Model Setup

- The long-term risky asset pays off at $t = 2$ as a binomial tree.
- Two groups of agents holding heterogeneous beliefs.
  - We denote optimists by h and pessimists by l.
  - In the basic model, we let $\pi_n^h > \pi_n^l$ for any $n \in \{0, u, d\}$.



Asset Market

- 1 unit of risky asset supply, $\mu \in (0, 1)$ units of optimists.
- On date 0, each optimist is endowed with 1 unit of asset and c dollars of cash.
  - Optimism motivates them to buy the remaining $1 - \mu$ units of assets from pessimists.
- The pessimists sit on the sideline, and can provide credit to the optimists.
  - We assume they always have sufficient cash to provide competitive financing to the optimists.
  - Their belief affects the financing cost.
- Risk neutral agents, zero interest rate.
- Short sales are not allowed.

Collateralized Debt Financing

- The optimists use their asset holdings as collateral to obtain debt financing.
- Only consider standard non-contingent debt contracts.
  - A non-contingent debt contract specifies a constant debt payment (face value) at maturity unless the borrower defaults.
  - By shifting control to the creditor after price declination, debt disciplines excessive risk-taking by optimists.
- In equilibrium, optimists always choose face value in $\left[\theta^2, \theta\right]$, as long as the asset price is between the optimists' and pessimists' asset valuation.
- In equilibrium, optimists do not save cash.
  - It is not desirable for any optimist to sell his asset on date 1.
  - He has to refinance his debt on date 1 if he uses short-term debt, or loses his asset to the creditor.

Long-Term Debt

- A long-term debt contract, collateralized by one unit of the asset.
  - It matures on date 2 with a face value of $F_L \in \left[\theta^2, \theta\right]$.
  - The random debt payment $\widetilde{D}_L\left(F_L\right) = \min\left(F_L, \widetilde{\theta}\right)$.
- On date 0, pessimistic creditors provide credit:

$$C_L\left(F_L\right) = E_0^l\left[\widetilde{D}_L\right] = \left(1 - \left(1 - \pi_0^l\right)\left(1 - \pi_d^l\right)\right) F_L + \left(1 - \pi_0^l\right)\left(1 - \pi_d^l\right)\theta^2.$$

- Financing cost to the optimistic borrower:

$$E_0^h\left[\widetilde{D}_L\right] = \left(1 - \left(1 - \pi_0^h\right)\left(1 - \pi_d^h\right)\right) F_L + \left(1 - \pi_0^h\right)\left(1 - \pi_d^h\right)\theta^2.$$

- Risky debt $(F_L > \theta^2)$ is costly because the creditor undervalues the payment in the higher states.
  - The risk-free debt $(F_L = \theta^2)$ is fairly valued but limits leverage.
  - What if the borrower wants a larger leverage?

Short-Term Debt

- ST debt matures on date 1, with face value $F_S \in \left[\theta^2, \theta\right]$.
- The borrower refinances at $t = 1$ by promising a new debt payment $F_{S,1}$ at $t = 2$: $E_n^l \left[\min\left(F_{S,1}, \widetilde{\theta}\right)\right] = F_S$.
  - In state u, the borrower just needs to promise $F_{S,1} = F_S$.
  - In state d, the maximum credit he can raise is

$$K_d \equiv \mathbb{E}_d^l \left[\min\left(\theta, \widetilde{\theta}\right)\right] = \pi_d^l \theta + \left(1 - \pi_d^l\right) \theta^2 < \theta.$$

1. $F_S \in \left[\theta^2, K_d\right]$. Riskless with date-0 credit $C_S(F_S) = F_S$.
   - Risk-free ST debt can raise as much as K_d, higher than θ^2.
   - In state d, refinance requires new risky debt with $F_{S,1} \geq F_S \geq \theta^2$..
2. $F_S \in (K_d, \theta]$. Risky.
   - in state d, the borrower forfeits the asset to the creditor.

Position of Optimists

- Suppose that an optimist uses a contract $\widetilde{D}$ and obtains an initial credit of $C\left(\widetilde{D}\right) \equiv \mathbb{E}_0^l\left[\widetilde{D}\right]$.
- Besides 1 unit of asset endowment, he buys additional x units from the market.
  - Collateralized borrowing. He can borrow $(1+x)\,C\left(\widetilde{D}\right)$ in total.
- Budget constraint: $c + (1+x)\,C\left(\widetilde{D}\right) = xp_0 \Rightarrow x = \frac{c+C\left(\widetilde{D}\right)}{p_0 - C\left(\widetilde{D}\right)}$.
  - Assuming he does not hold any cash, which is verified in equilibrium.
- His date-0 utility is

$$V\left(\widetilde{D}\right) = \underbrace{\frac{c+p_0}{p_0 - C\left(\widetilde{D}\right)}}_{\text{leverage effect}} \underbrace{\left[\mathbb{E}_0^h\left(\widetilde{\theta}\right) - \mathbb{E}_0^h\left(\widetilde{D}\right)\right]}_{\text{debt-cost effect}}$$

Maturity Choice

- Consider two ST and LT contracts giving the same date-0 credit (i.e., fixing the leverage effect).
- Debt-cost effect: ST debt has lower cost if and only if

$$\frac{\pi_0^h}{\pi_0^l} > \frac{\left(1-\pi_0^h\right)\pi_d^h}{\left(1-\pi_0^l\right)\pi_d^l}.$$

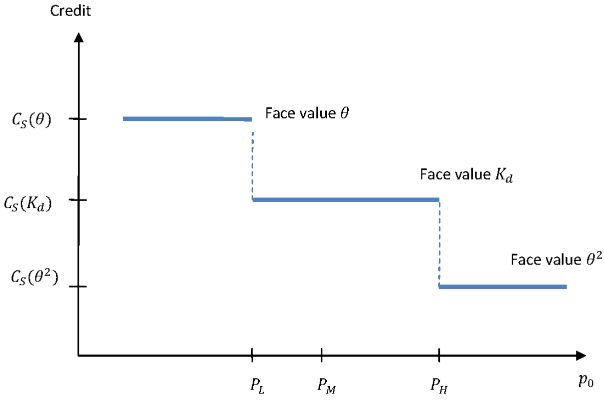
- ST debt needs refinancing: better or same term after good news, but worse term after bad news.
  - Pay less in high states, more in low states. preferred by optimists!
  - Initial belief dispersion at $t = 0$ stimulates speculative incentives.
- After bad news (state d), belief dispersion leads to rollover risk.
  - The refinancing $F_{S,1}$ payment is undervalued by the creditor.
  - Rollover risk is endogenously determined by heterogeneous beliefs.

Maturity Choice: The Static Intuition

- Geanakoplos (2009): optimists always prefer the maximum risk-free short-term leverage.
- Examine the short-term K_d contract: initially risk-free.
  - In state u, refinance by another risk-free contract;
  - In state d, refinance by turning the asset to creditor.
- This intuition ignores the rollover risk and does not hold if the future belief dispersion in state d is sufficiently large.
- Our model shows that short-term debt is desirable only if initial belief dispersion is high and future dispersion in state d is low.
  - Long-term debt could be optimal because it hedges the financing cost against future downturns.

Optimal Short-term Debt Face Value: Leverage Choice

- Suppose that short-term debt is desirable.
  - The default risk is different for F_S inside $\left[\theta^2, K_d\right]$ and $[K_d, \theta]$.
- Two thresholds P_H and P_L for price p_0. The higher the asset price p_0, the lower the leverage that the optimists will take.



Equilibrium of Asset and Credit Markets on Date 0

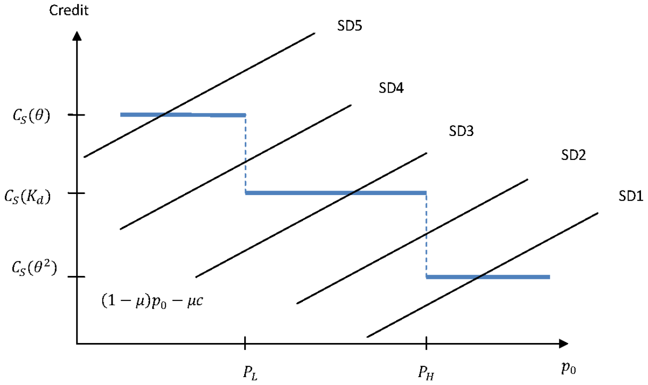
- Recall the optimists (with measure μ) buy $x = \frac{c+C(\widetilde{D})}{p_0 - C(\widetilde{D})}$ units from the market, and pessimists sell $1-\mu$ to the market.
- Market clearing: the optimists' asset purchases $\mu x = 1 - \mu$.
- If all the buyers use the same debt contract $\widetilde{D}(p_0)$, then

$$\mu \frac{c + C\left(\widetilde{D}(p_0)\right)}{p_0 - C\left(\widetilde{D}(p_0)\right)} = 1 - \mu$$

which is equivalent to

$$\underbrace{C\left(\widetilde{D}(p_0)\right)}_{\text{credit demand}} = \underbrace{(1-\mu)\,p_0 - \mu c}_{\text{cash shortfall}}.$$

Market Equilibrium



Equilibrium on Date 1

- We look for shadow price on date 1, which has two states u and d.
- In state u, the optimistic asset holders are in a good financial situation, and the asset price is determined by their valuation:

$$p_u = \mathbb{E}_u^h\left[\widetilde{\theta}\right] = \pi_u^h + \left(1 - \pi_u^h\right)\theta.$$

- In state d, the equilibrium depends on the date-0 debt contracts:
  - If all asset holders use riskless debt contracts, then optimists who hold the asset determines the price:

$$p_d = \mathbb{E}_d^h\left[\widetilde{\theta}\right] = \pi_d^h\theta + \left(1 - \pi_d^h\right)\theta^2.$$

  - Otherwise, some asset holders are forced to transfer assets to pessimistic creditors:

$$p_d = \mathbb{E}_d^l\left[\widetilde{\theta}\right] = \pi_d^l\theta + \left(1 - \pi_d^l\right)\theta^2.$$

Heterogeneous Beliefs and Asset Price Cycles

- Standard Miller result: in the absence of short-sales, heterogeneous beliefs cause asset overvaluation.
- We evaluate this result after accounting for optimists' financing cost.
- We use the following baseline parameters:

$$\begin{aligned} \mu &= 0.3, c = 0.5, \theta = 0.4, \pi_0^h = 0.7, \pi_0^l = 0.3, \\ \pi_u^h &= 0.6, \pi_u^l = 0.4, \pi_d^h = 0.6, \pi_d^l = 0.4. \end{aligned}$$

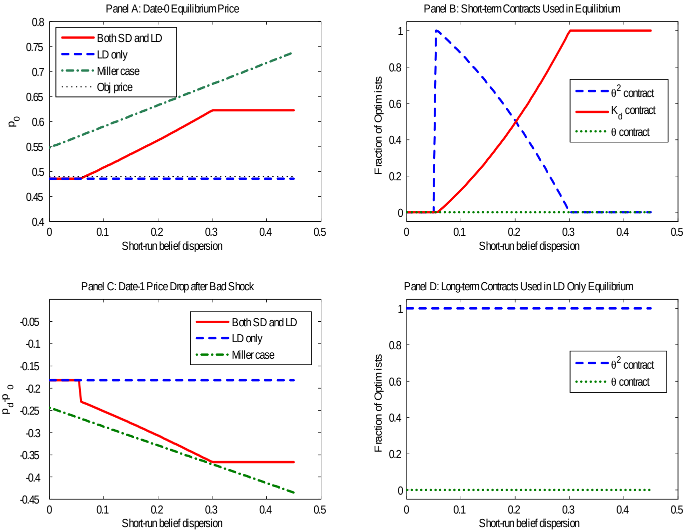
- To evaluate the effect of initial belief dispersion on date 0 (speculative incentives), we let

$$\pi_0^h = 0.5 + \delta_0 \text{ and } \pi_0^l = 0.5 - \delta_0.$$

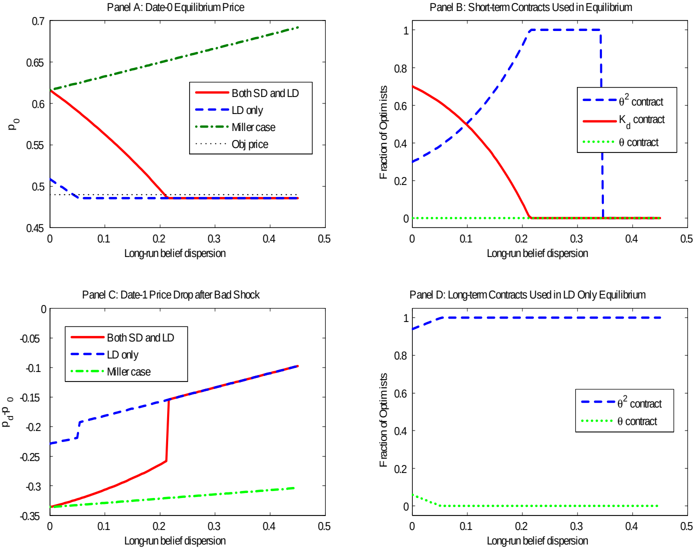
- To evaluate the effect of belief dispersion in state d of date 1 (rollover risk), we let

$$\pi_d^h = 0.5 + \delta_d, \text{ and } \pi_d^l = 0.5 - \delta_d.$$

The Initial Belief Dispersion on Date 0



The Future Belief Dispersion in State d of Date 1



Discussion on Short-term Credit Booms

- Several episodes of short-term credit booms:
  - before the credit crisis of 2007-2008;
  - before the debt crises of emerging economies in 1990s;
  - before the great crash of 1929.
- A short-term credit boom can fuel an asset-market boom and then exacerbate the downturn after the asset fundamental deteriorates.
  - The importance of financing choices for understanding asset-market dynamics and financial crises.
- This model characterizes a set of conditions for short-term credit booms to emerge:
  - large short-term belief dispersion;
  - and future belief convergence.

Discussion on Heterogeneous Beliefs and Asset Bubbles

- There is a large literature on asset bubbles generated by heterogeneous beliefs and short-sales constraints.
  - Miller (1977) and Chen, Hong and Stein (2002): a larger belief dispersion leads to a higher asset price and a lower expected return.
  - Harrison and Kreps (1978), Morris (1996) and Scheinkman and Xiong (2003): more volatile belief dispersion leads to more valuable resale option and more frequent asset trading.
- These studies ignore financing cost and heterogeneous beliefs in different horizons.
- This model highlights the differences between initial and future belief dispersion when optimists need financing.
  - A higher initial belief disperion can lead to a higher asset price;
  - while a higher future belief dispersion after fundamental deterioration reduces asset price.

Related Literature

- Credit contraction during crises.
  - Procyclical leverages: Adrian and Shin (2008) and Geanakoplos (2009);
  - Increased margins in crises, e.g., Brunnermeier and Pedersen (2009);
  - Shortened debt maturity during crises, e.g., He and Xiong (2009a) and Brunnermeier and Oehmke (2009).
- Reasons for pervasive use of ST debt:
  - Agency problems inside firms: Calomiris and Kahn (1991), Diamond and Rajan (2009).
  - ST debt is less information sensitive: Gorton and Pennacchi (1990).
  - Signaling: Diamond (1991).
  - This model emphasizes speculative incentives as a driving force, and links debt maturity choice to asset market dynamics.
- Heterogeneous beliefs and security designs:
  - Garmaise (2001), and Landier and Thesmar (2008).