On the Implications of Risk-Shifting Models of Bubbles

Gadi Barlevy
Federal Reserve Bank of Chicago

Motivation

Can theoretical models of bubbles (price $\neq$ fundamentals) match historical episodes of "bubbles" (price booms and busts)?

Why do we care? Underlying model can matter for welfare, policy

Focus on risk-shifting models: Allen-Gorton (1993), Allen-Gale (2000)

Why these models and not monetary or greater-fool models?

- Credit is central for existence of bubble in risk-shifting models
- Easy access to credit a common feature of historical episodes

Summary of Results

Risk-shifting models capture key features of historical episodes:

- Dynamic version of model can generate *booms and busts*

  BUT ... extent of overvaluation distinct from rapid price growth

  - Overvaluation depends on funds supplied to market
  - Price appreciation depends on riskiness of trading

- Dynamic model can generate *speculative behavior* (churning)

- Bubbles can be associated with *low risk premia*

- Bubbles associated with *certain types of financial contracts*

Overview

- Static model (overvaluation)

- Dynamic model (booms and busts, speculation)

- Endogenous contracting (contract choice)

Static Model

Essentially Allen and Gale (2000), but drop unlimited borrowing

Asset: fixed supply (set to 1), no short sales, stochastic payoff

$$\text{Dividend } d = \begin{cases} D & \text{w/prob } \epsilon \\ 0 & \text{w/prob } 1-\epsilon \end{cases} \Rightarrow \quad \text{fundamental} = \epsilon D$$

Assets endowed to one group of agents (original owners)

Can be bought by second group (potential buyers)

Potential buyers penniless $\Rightarrow$ borrow from third group (creditors)

Static Model (continued)

No bubble unless some borrowers don't buy risky assets

Two types of potential buyers:

- Non-entrepreneurs – only choice is to buy assets
- Entrepreneurs – can either buy assets or produce

Production: $R > 1$ units of output per input, max capacity $= 1$

$n \equiv \#$ of non-entrepreneurs; $\phi \equiv$ fraction of non-entrepreneurs

Credit market operates as follows:

- Creditors lend 1 unit per borrower, choose rate r
- Assume cost of default to borrower k, let $k \to 0$

Equilibrium:

1. Asset market clears
2. Zero expected profits to lender
3. There exists no contract that makes both parties better off

Lenders vie for entrepreneurs, fund both types, asset market clears

Equilibrium in asset market depends on # of buyers, so n and R

Figure 1: No Bubble if R < R*(n)

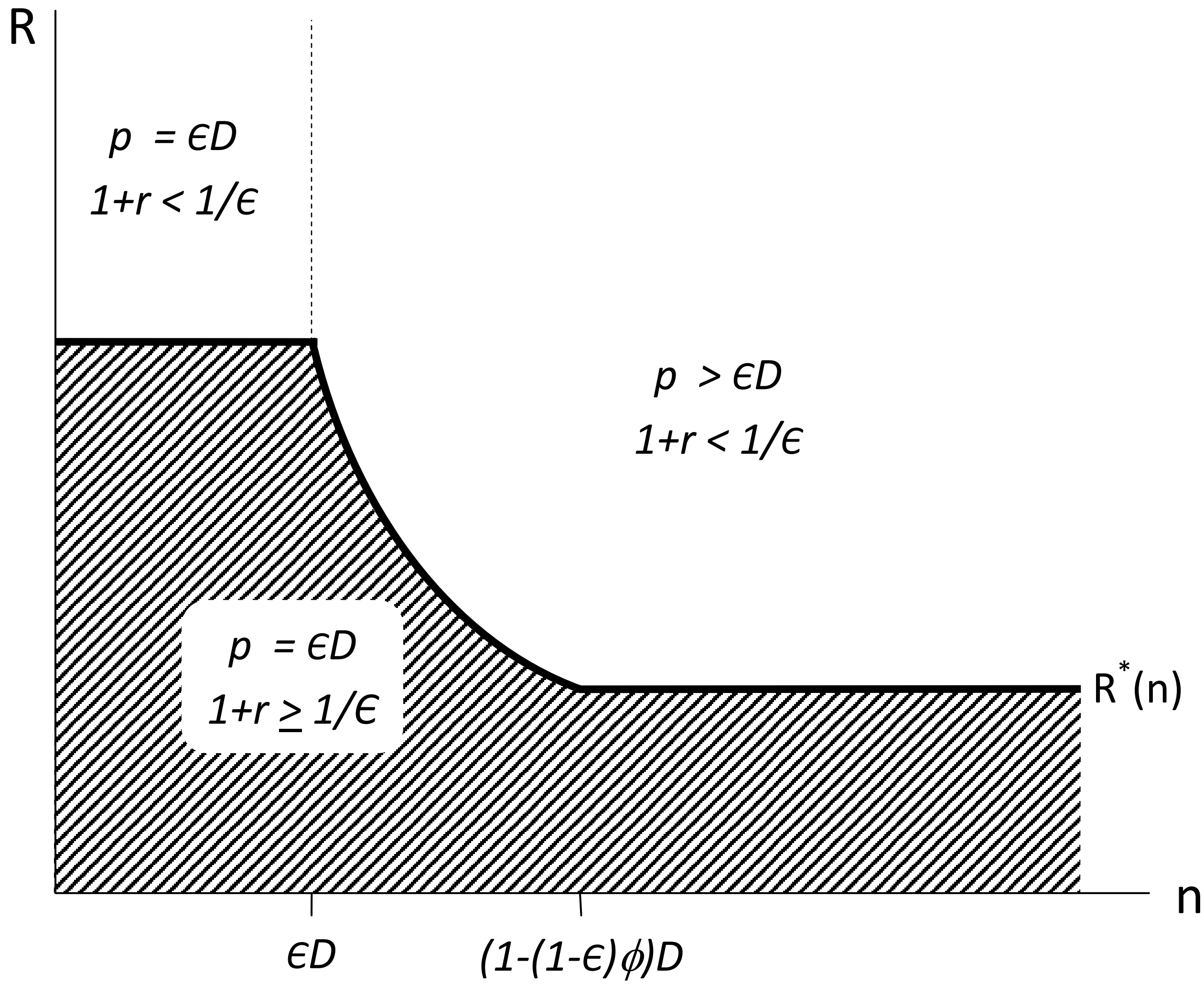
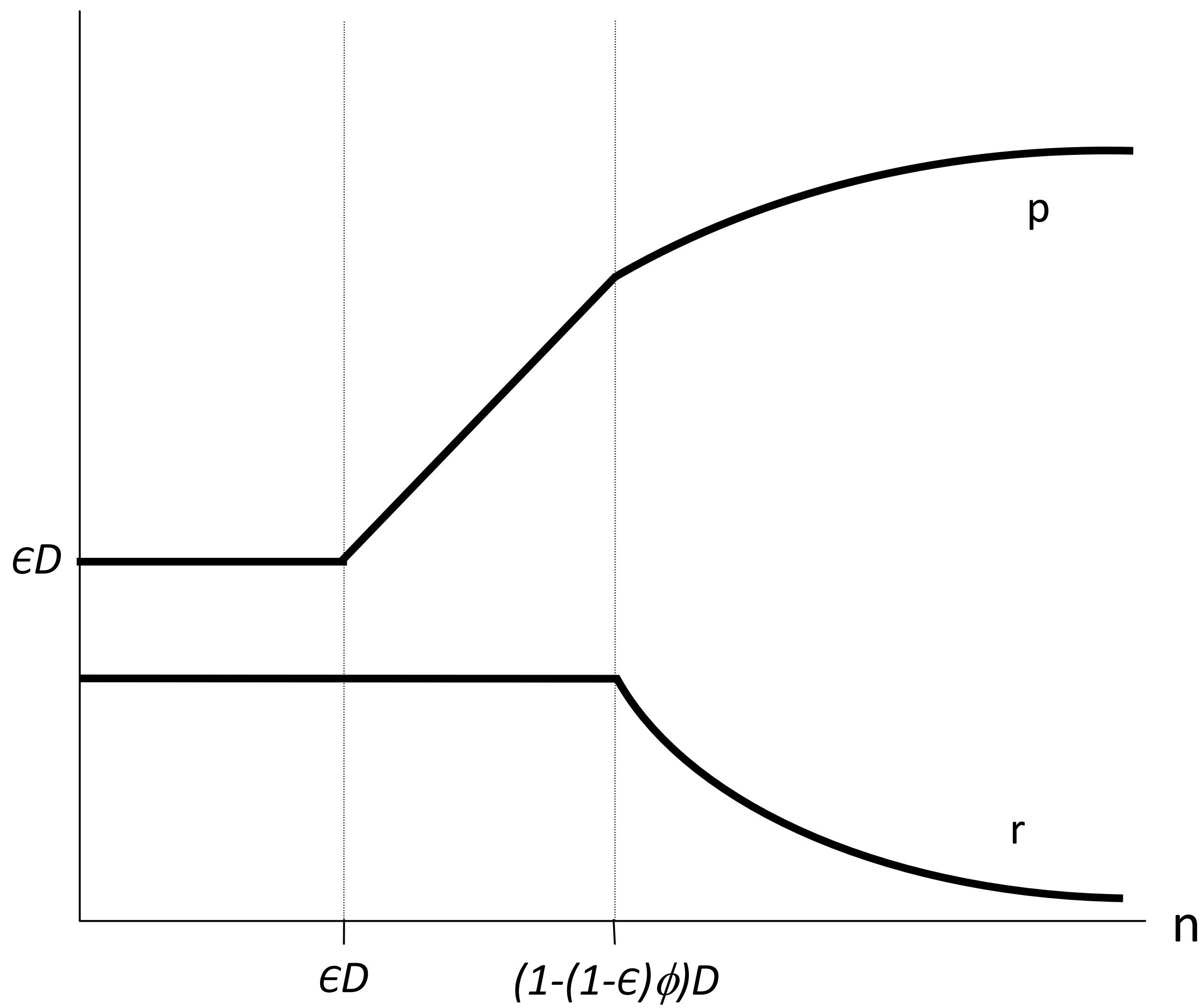


Figure 2: p and r as functions of n when $R > R^{*}(n)$



Summary of One-Period Model

- Overvaluation $(p - \epsilon D)$ depends on what agents borrow in total
- Overvaluation discourages buying risky assets $(D - (1+r)\,p \downarrow)$
  $\Rightarrow$ Fewer risky borrows, so lower risk premia

Dynamics: Two-Period Model

Try to remain as close as possible to static model

Two periods, indexed $t \in \{1, 2\}$; no discounting

Asset: same as before, d paid at end of date 2

Potential buyers arrive at exogenous dates, cannot delay

$n_t \equiv \#$ of non-entrepreneurs at date t

$\phi \equiv$ fraction of non-entrepreneurs at date t

Entrepreneurs: same technology, output comes at end of date 2

$\Rightarrow$ Creditors lend 1 unit per borrower, due at end of date 2

Equilibrium in Two-Period Model

Model same as static model, with two exceptions:

1. Original owners who don't sell at date 1 can sell at date 2

2. Agents who buy at date 1 can sell at date 2

Nevertheless, equilibrium same as static model

Proposition: In eqbm, $p_1 = p_2 = p$ where p is price in one-period model where $n = n_1 + n_2$. There is no speculation.

No price appreciation even if $n_2 > n_1$

Why Are There No Dynamics?

Original owners act to rule out price appreciation:

- If know $p_2 > p_1$ for sure, wait to sell at date 2
- But then market wouldn't clear in date 1
- $p_2 = p_1 \Rightarrow$ speculation is unprofitable

Certainty about date 2 plays a key role

Blanchard-Watson (1982): in deterministic model, bubble grows at risk-free interest rate (here 0 because no discounting)

Adding Risk

Blanchard-Watson: if bubble can burst, price $\uparrow$ at risk-adjusted rate

Intuition: waiting risks losing option to sell asset for inflated price

Capital gain if bubble doesn't burst compensates trader

Why might bubble burst? e.g., d revealed before $t = 2$ w/prob q

If n_1 not too large, original owners indifferent when to sell:

$$\begin{aligned} p_1 &= q\epsilon D + (1-q)\, p_2 \\ \epsilon D + b_1 &= q\epsilon D + (1-q)\,(\epsilon D + b_2) \\ b_1 &= (1-q)\, b_2 \end{aligned}$$

Even if d revealed to be high, lose option to sell asset for profit

Key insight: booms possible, but *only* if people view trade as risky

Equilibrium when Bubble Might Burst

At date 1, non-entrepreneurs buy assets, entrepreneurs produce

At date 2, if d uncertain, non-entrepreneurs buy, demand is n_2/p_2

On supply side, heterogeneity:

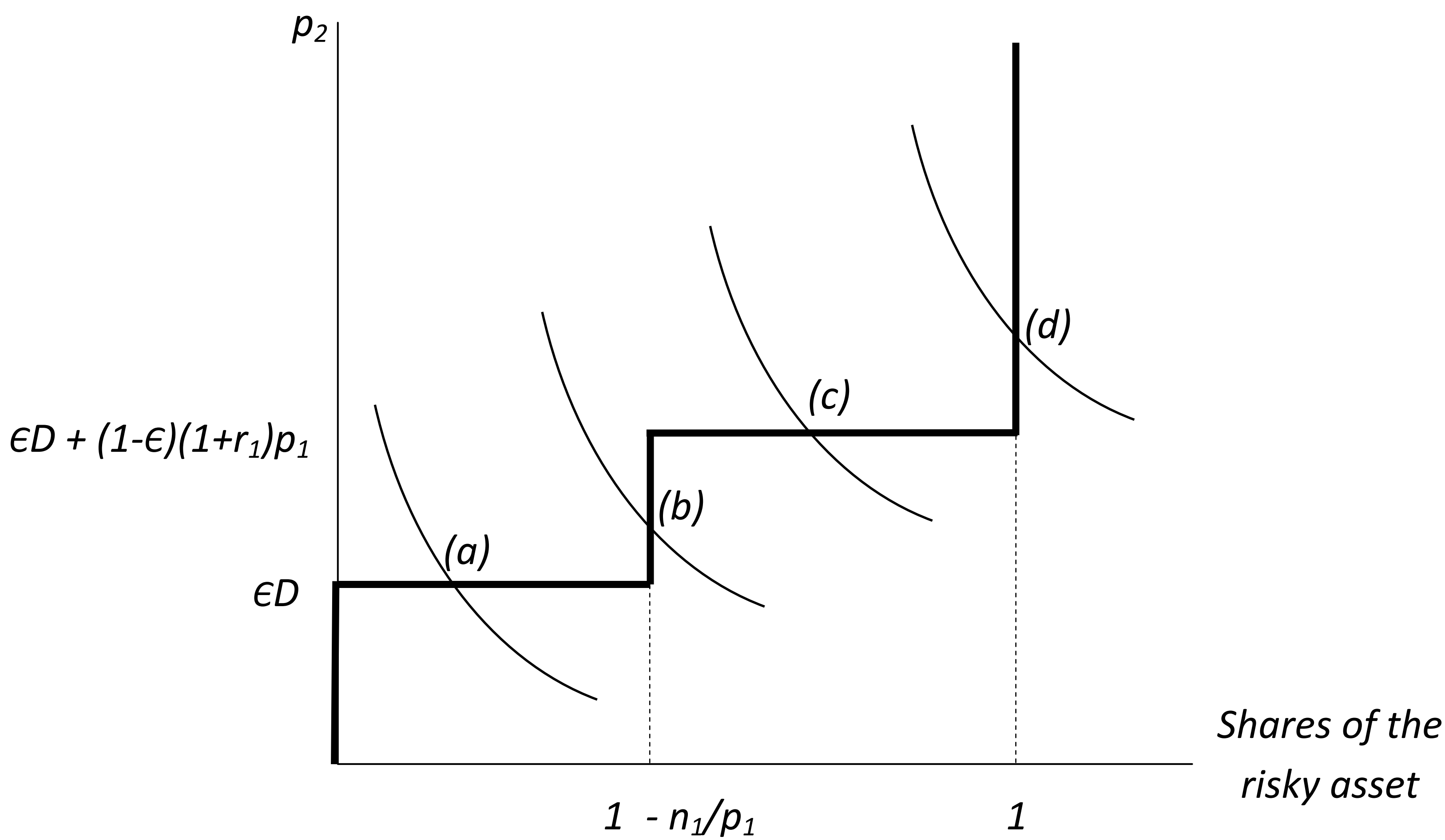
- Original owners will sell if $p_2 > \epsilon D$
- If buy at date 1, sell if

$$\frac{p_2}{p_1} - (1 + r_1) \geq \epsilon \left(\frac{D}{p_1} - (1 + r_1) \right)$$

$$p_2 \geq \epsilon D + (1 - \epsilon)(1 + r_1) p_1$$

Supply curve is a step function

Figure 3: Market for Assets at Date 2



Types of Equilibria

We can partition (n_1, n_2) space to regions w/unique eqbm:

a. Some but not all original owners sell at date 2 ($p = \epsilon D$)

b. All original owners sell at date 2, none of the date 1 buyers

c. Some but not all date 1 buyers sell at date 2

d. All date 1 buyers sell at date 2

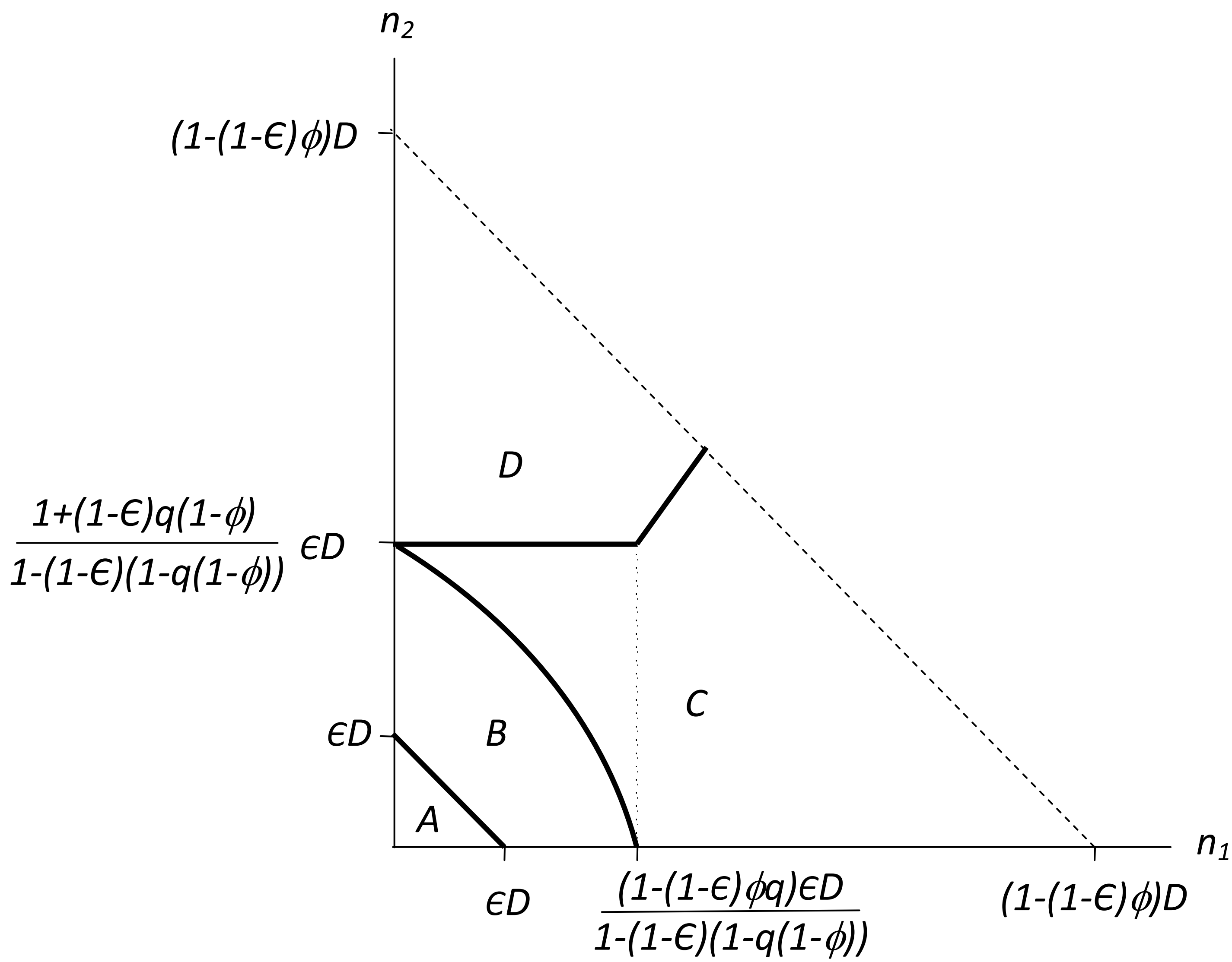
Equilibria (c) and (d) involve speculation (need risk, high $n_1 + n_2$)

Implications for Interest Rates

Lower risk premia with speculation than without speculation

Prob of repayment is $(1 - q) + q\epsilon$ rather than ϵ

Figure 4: Partition of Equilibria in (n_1,n_2) Space



Endogenous Contracting

Overview of results:

1. Pooling debt contract can be optimal in 1-period model

2. Creditors will try to design contracts to contain losses:

   If we can pay agents not to speculate, bubble cannot occur
   Intuition: buying overvalued asset inefficient way to offer rents
   Paying agents not to speculate could draw in non-participants

3. Lenders may offer backloaded or smaller low-interest loans

Conclusions

Risk-shifting models can capture certain features of "bubbles":

- Boom-busts (bubble bursts when d revealed, p falls if $d = 0$)
- Speculation (if there are enough traders and risk)
- Speculation and overvaluation may lead to low risk premia

Testable implications: contract choice, e.g. Barlevy-Fisher (2011)

Challenges: price growth only if trading is risky; may be inconsistent with conventional view of housing market