ECON 747 – LECTURE 15: BUBBLES

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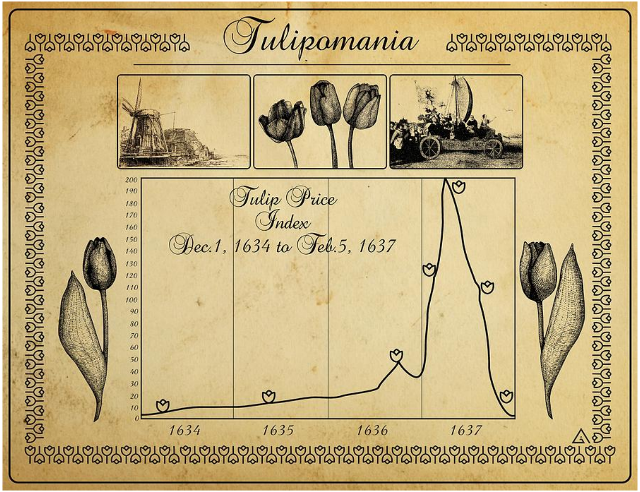
MOTIVATION

- Today we think about a concept that frequently appears in the discourse on financial markets their relation to the macroeconomy: **bubbles**

EXAMPLES OF BUBBLES?

- The Tulip Mania in the Netherlands, 1624-37
- The South Sea Bubble of 1720
- The Dot-Com Bubble of the 1990's
- The US Housing Bubble of the 2000's
- Bitcoin? Dogecoin? NFTs?

EXAMPLES


Tulipomania
Tulip Price
Index
Dec.1, 1634 to Feb.5, 1637
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1634
1635
1636
1637

EXAMPLES

- The "Viceory" tulip was sold at a price equivalent to ten times the annual wage of a skilled Dutch crafts worker

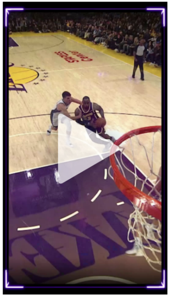
EXAMPLES

- Is this a bubble?

EXAMPLES

1. LeBron James (2019-20 dunk)

Sold for $208,000 in February 2021
Set: Cosmic / Serial number: 29



- Is this a bubble?

HOW TO THINK ABOUT BUBBLES?

- Large deviations of asset prices from *fundamental value*, followed by sharp drops
- Possible explanations:
  - Psychology, herd behavior
  - Asymmetric information
  - ...
- A nice brief overview is provided by Brunnermeier (2009)

RATIONAL BUBBLES: BLANCHARD-WATSON

MOTIVATION

- Blanchard and Watson (1982) provide a formal treatment of asset price bubbles
- Main question: *are bubbles consistent with rationality?*
- Why is this a relevant question?
  - Rationality puts strong restrictions on behavior
  - In some sense the most challenging environment for a bubble to arise
- See also Martin and Ventura (2018) for a survey on rational bubbles

FINDING

- Rational expectations do <u>not</u> imply that the price of an asset is equal to its fundamental value!

SETTING

- Net return of an asset that pays dividend d_t is given by

$$r_t^a = \frac{p_{t+1} - p_t + d_t}{p_t}$$

- No-arbitrage condition

$$\mathbb{E}(r_t^a | \Omega_t) = r$$

Ω_t is the information set at date t, which is assumed to be common to all agents

SETTING

- We have assumed above that there is a constant risk free rate, agents are risk neutral and there are no frictions in asset trade
  - Recall also the Lucas tree model from Lecture 4
- The equations on the previous page imply:

$$\mathbb{E}(p_{t+1}|\Omega_t) - p_t + d_t = rp_t$$

$$p_t = \frac{d_t + \mathbb{E}(p_{t+1}|\Omega_t)}{1 + r_t}$$

FUNDAMENTAL VALUE

- We can iterate forward this equation to get

$$p_t^* = \sum_{i=0}^{\infty} \left(\frac{1}{1+r} \right)^{i+1} \mathbb{E}(d_{t+i}|\Omega_t)$$

- Note that we have used the law of iterated expectations

$$\mathbb{E}(\mathbb{E}(\cdot|\Omega_{t+i})|\Omega_t) = \mathbb{E}(\cdot|\Omega_t)$$

- p_t^* is the "fundamental" value, the expected net present value of dividends

FUNDAMENTAL VALUE

- It turns out that p_t^* is not the only solution to the equation

$$\mathbb{E}(p_{t+1}|\Omega_t) - p_t + d_t = rp_t$$

MULTIPLE SOLUTIONS

- Any solution of the following form satisfies the law of motion in p_t derived above:

$$p_t = p_t^* + b_t$$

with

$$p_t^* = \sum_{i=0}^{\infty} \left(\frac{1}{1+r} \right)^{i+1} \mathbb{E}(d_{t+i}|\Omega_t)$$

and

$$\mathbb{E}(b_{t+1}|\Omega_t) = (1+r)b_t$$

BUBBLES

- The b_t term must grow (since $r > 0$) but the condition above allows a variety of different processes, including for example deterministic growth
- Any solution of this type implies deviations from fundamentals without violating no-arbitrage restrictions implied by the rational expectations environment
- Blanchard and Watson construct an example in which b_t embodies features that are commonly thought to be described as a “bubble”

- Suppose the following:

$$b_t = \begin{cases} \frac{1+r}{\pi} b_{t-1} + \mu_t & \text{with prob. } \pi \\ \mu_t & \text{with prob. } 1-\pi \end{cases}$$

where $\mathbb{E}(\mu_t | \Omega_t) = 0$

- How to interpret this process?
- With probability π:
  - The bubble lasts
  - The return on the asset exceeds r
- With probability $1-\pi$:
  - The bubble bursts
  - The price of the asset goes back to the fundamental value
- The average duration of the bubble is $\frac{1}{1-\pi}$

BUBBLES

- You can easily simulate this process on a computer to see what it looks like
- You can essentially simulate a bubble(-like) process, without assuming any deviation from rational behavior

Duration dependence

- In principle, the probability that the bubble bursts may be a function of the time over which it has lasted
- The price accelerates if the probability of a bust increases

EXTENSION: BUBBLE RELATED TO FUNDAMENTALS

- As an extension, Blanchard and Watson consider an example of a bubble that is related to the fundamental value
- Consider a military stock which pays 1 if there is a war and 0 if there is no war
- Suppose a war starts and the probability that it lasts is π

EXTENSION: BUBBLE RELATED TO FUNDAMENTALS

- The fundamental variables of the stock is

$$p_t^* = \sum_{i=0}^{\infty} \left(\frac{1}{1+r} \right)^{i+1} \mathbb{E}(d_{t+i}|\Omega_t) = \sum_{i=0}^{\infty} \left(\frac{1}{1+r} \right)^{i+1} \pi^i$$

EXTENSION: BUBBLE RELATED TO FUNDAMENTALS

- Suppose the following bubble arises

$$
\begin{aligned}
b_t &= b_0 \\
b_{t+i} &= \begin{cases} \frac{1+r}{\pi} b_{t+i-1} & \text{if war at } t+1 \\ 0 & \text{if no war at } t+1 \end{cases}
\end{aligned}
$$

- This leads to an increase of the price above fundamentals, and a collapse in both the bubble and the fundamental price when the war ends

GENERALIZATIONS: RISK AVERSION

- What about risk aversion?
- We have seen that the bubble term is required to grow according to

$$\mathbb{E}(b_{t+1}|\Omega_t) = (1+r)b_t$$

- With risk aversion, the agents would require additional compensation for the risk that the bubble bursts
- Therefore the b_t would need to grow faster than $1+r$

GENERALIZATIONS: IMPERFECT INFORMATION

- If agents do not have the same information, they will have a different perception of the fundamental value of the asset, given by condition on $\Omega_{j,t}$ rather than Ω_t
- This means that agents do not perceive the same bubble
- There may be agent-specific bubbles satisfying

$$\mathbb{E}(b_{t+1}|\Omega_{j,t}) = (1+r)b_t$$

- Could some agents in the market know there is a bubble while others do not?
  - Maybe uninformed (yet rational) traders matter for starting bubbles ...

BUBBLES AND TRANSVERSALITY

- Arbitrage does not prevent bubbles, but are there other conditions that could (through rationality or market clearing)?
- Successive iteration of the condition required for the bubble term implies that for $b_t > 0$, we get

$$\lim_{i \to \infty} \mathbb{E}(b_{t+i} | \Omega_t) = +\infty$$

- While the probability that a bubble bursts tends to 1 over time, the price increases at a rate that implies an ever growing expected value of the price

- Implications:
  - Assets that are redeemable a given price at a given time cannot satisfy this condition. Therefore bonds (that are not perpetuities) cannot exhibit bubbles.
  - There cannot be negative bubbles if the asset can be disposed of at no cost

BUBBLES AS PONZI SCHEMES

- Suppose there is a finite number of infinitely lived market participants
- Suppose the price of an asset is above its fundamental price
- The only reason to hold the asset is to resell it at some time and realize the capital gain
- This means that all agents intend to sell the asset in finite time, so nobody will be holding the asset after some finite time period
- This cannot be an equilibrium!

BUBBLES AS PONZI SCHEMES

- If the market is made up of generations of new participants the above arguments do not hold and a bubble may emerge
- This idea is akin to the formal model of Samuelson (1958)
  - Money as a bubble asset in an OLG structure

REAL EFFECTS OF BUBBLES

- Bubbles can have persistent negative effects on real allocations
- Think about housing:
  - Suppose the fundamental price of houses is given by the net present value of housing services, "rents"
  - Suppose there is a bubble in which agents are willing to pay more for houses than the fundamental value justifies
  - The higher price results in higher returns for housing construction and thus a lager housing stock in the future
  - With an unchanged demand for housing, this implies lower rents in the future
  - This means that the bubble decreases the fundamental value of houses

REAL EFFECTS OF BUBBLES

- Can bubbles have *positive* effects?
- Maybe: perhaps there are circumstances in which bubbles can reallocate resources from unproductive to productive use?
- Martin and Ventura (2012) show theoretically how bubbly episodes can have permanent positive effects on real output growth

THE BOTTOM LINE

- Deviations of asset prices from the fundamental value of the asset are consistent with rational expectations

Bibliography

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