

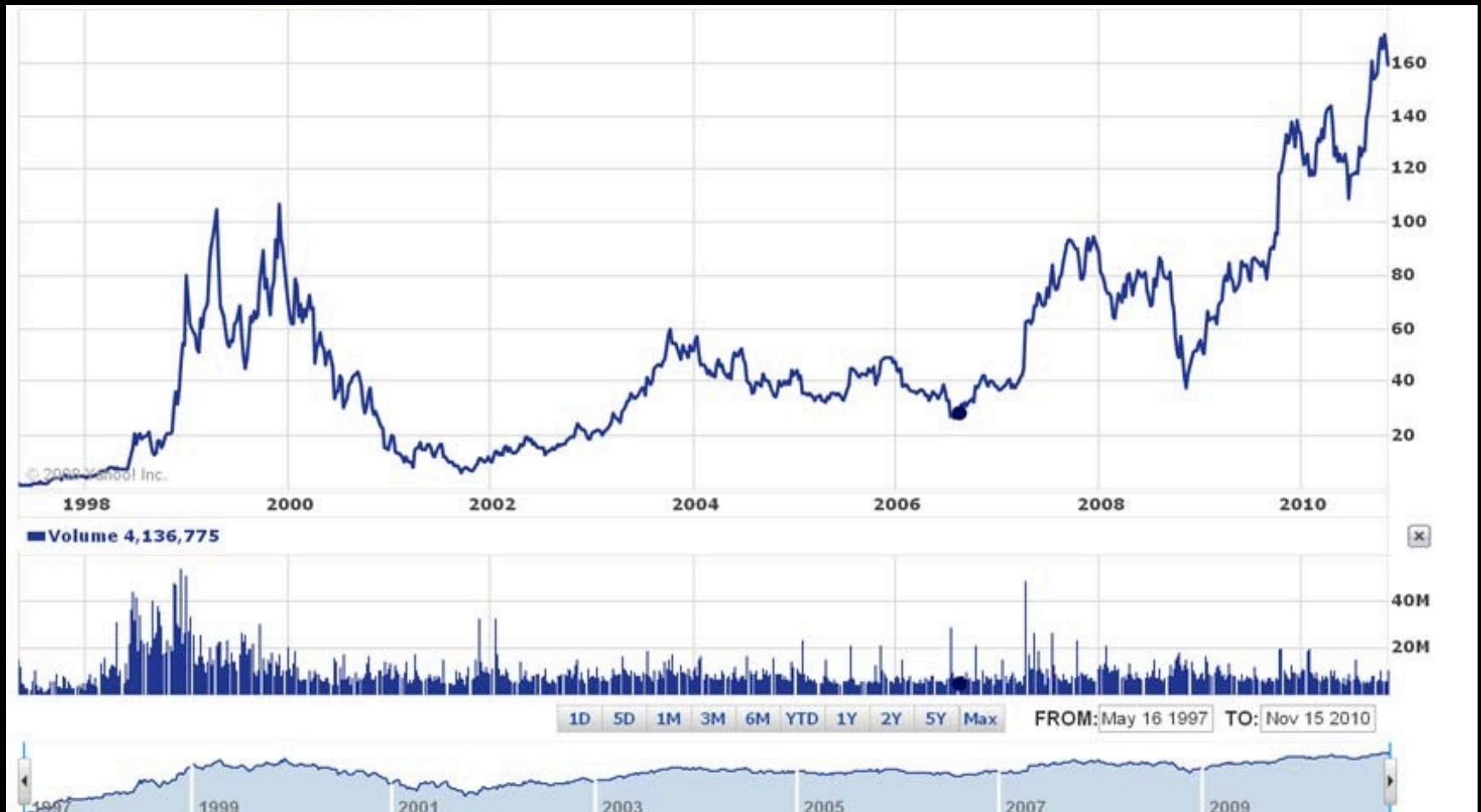
LECTURE 6: FINANCIAL MARKETS EXPERIMENTS - BUBBLES AND CRASHES

- Reading
 - Plott, Charles and Noussair, Charles: “Bubbles in Asset Markets: Common Knowledge Failure or Confusion?” In: Handbook of Experimental Economic Results, C. Plott and V. Smith, eds., 2008.
 - Noussair, Charles, Richter, Gregers, and Tyran, Jean-Robert (forthcoming): “Money Illusion and Nominal Inertia in Experimental Asset Markets”, Journal of Behavioral Finance.
- Learning outcomes
 - Understand how financial markets can be implemented in an experiment
 - Be familiar with the conditions that can cause bubbles in financial market experiments

Stock market: Nasdaq composite



Stock market: Amazon Inc.



Stock market: Dow Jones



Financial Markets Experiments

- Basic idea:
 - artificial asset
 - pays a (random) dividend each period
 - in addition possibly a final buyout and possibly taxes
 - asset can be traded every period (e.g. double auctions)
 - insufficient backward induction can lead to **bubbles** (prices much higher than fundamental values)
 - when backward induction “kicks in”, **crashes** (rapid declines in prices) result

Financial Markets Experiments

- Note:
 - sufficient if traders **believe others** have limited foresight
 - thus **expectations** are crucial
 - in real asset markets, often hard, e.g., to distinguish whether a bubble is irrational or whether expectations were rational but a low-probability shock lead to crash
 - in experiment, fundamental value can be made common knowledge
 - thus bubbles can be attributed to bounded rationality or expectation of others' bounded rationality

Stock market with irrational price bubbles

(Smith et. al. 1988)

- Assets generate revenue for 15 periods, either \$.6 or .28 or .08 or .00 each with probability 1/4.
 - Expected per period return is \$.24.
 - Expected value of asset in period 1 is \$ 3.6, in period 15 \$.24.
- 9 traders are endowed with assets and experimental cash.
- 3 traders have 3 units, 3 have two units and 3 have one unit of the asset.
- Cash endowment is adjusted such that the expected value of everybody's endowment is the same.
- Assets are traded for cash under the DA-institution.

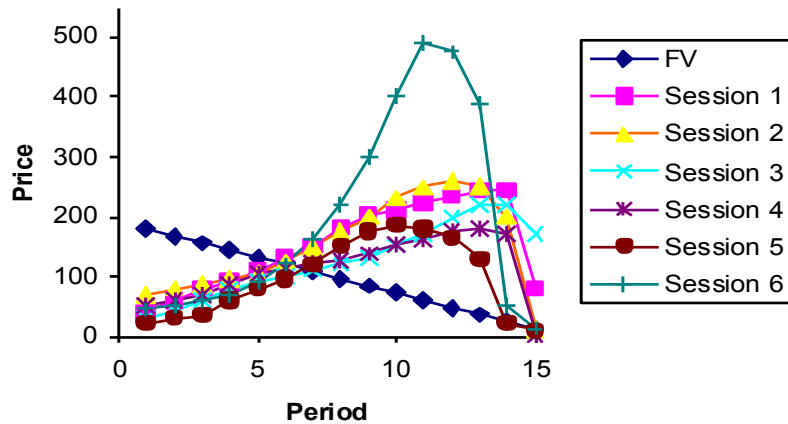
- At the end of each period one of the four states of the world occurs, which generates the corresponding dividend payment for the asset holders.
- Cash is transferred to future periods. Real money earnings are equal to amount of cash at the end.
- Only assets that are owned can be sold and assets have to be bought by currently owned cash.
- Trade only occurs if traders have different risk attitudes or different expectations regarding asset values.
- Whatever the mix of risk attitudes, rational expectations of asset prices rule out price bubbles.

Predictions (if everybody is rational)

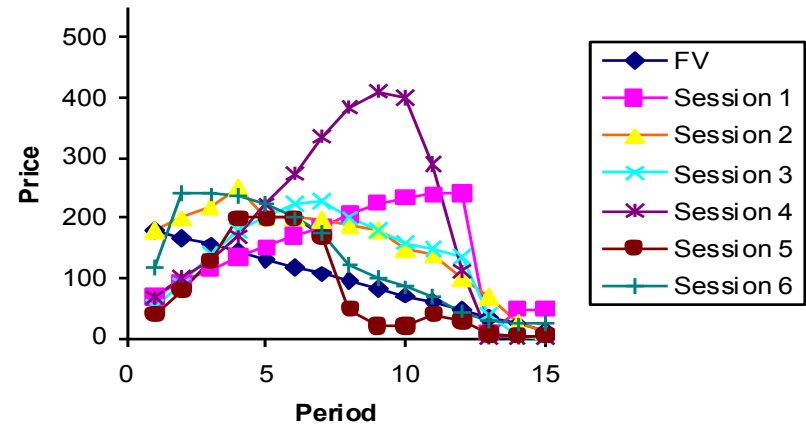
- In case of rational and risk neutral traders the asset value in any period is, by backwards induction, equal to the expected value of the asset.
- Therefore only trades at the expected value should occur, if they occur at all. Under near risk neutral agents we thus expect low trading volume at prices near the expected value.
- Suppose that for risk loving agents the certainty equivalent of the asset is $.24 + \varepsilon$ ($\varepsilon > 0$ but small) per period while for risk averse agents it is $.24 - \varepsilon$.
- Then, under rational expectations, the price in period 15 must be within the ε -neighbourhood of .24. The maximum price of the asset in t is then $(T-t+1)(.24 + \varepsilon)$.

Typical Market Prices in Experiments

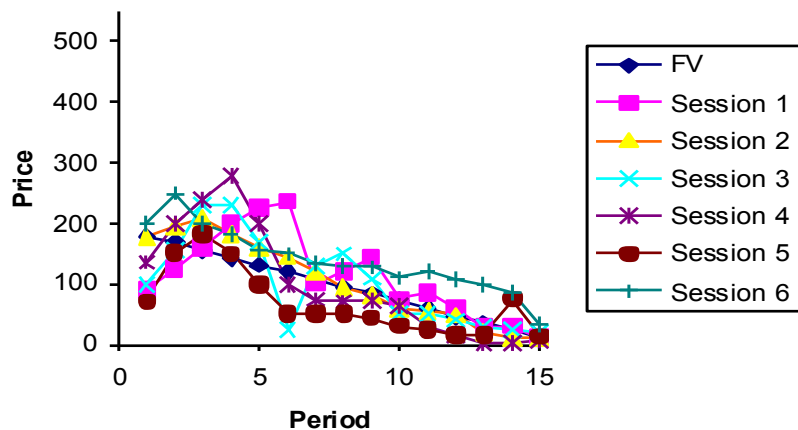
Asset 1



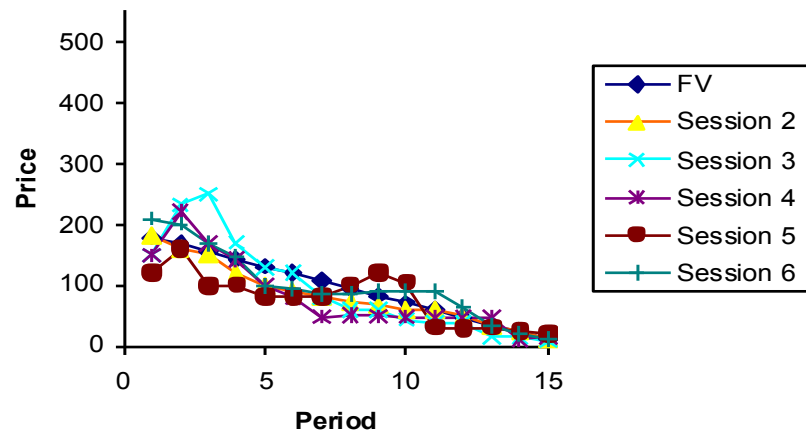
Asset 2



Asset 3



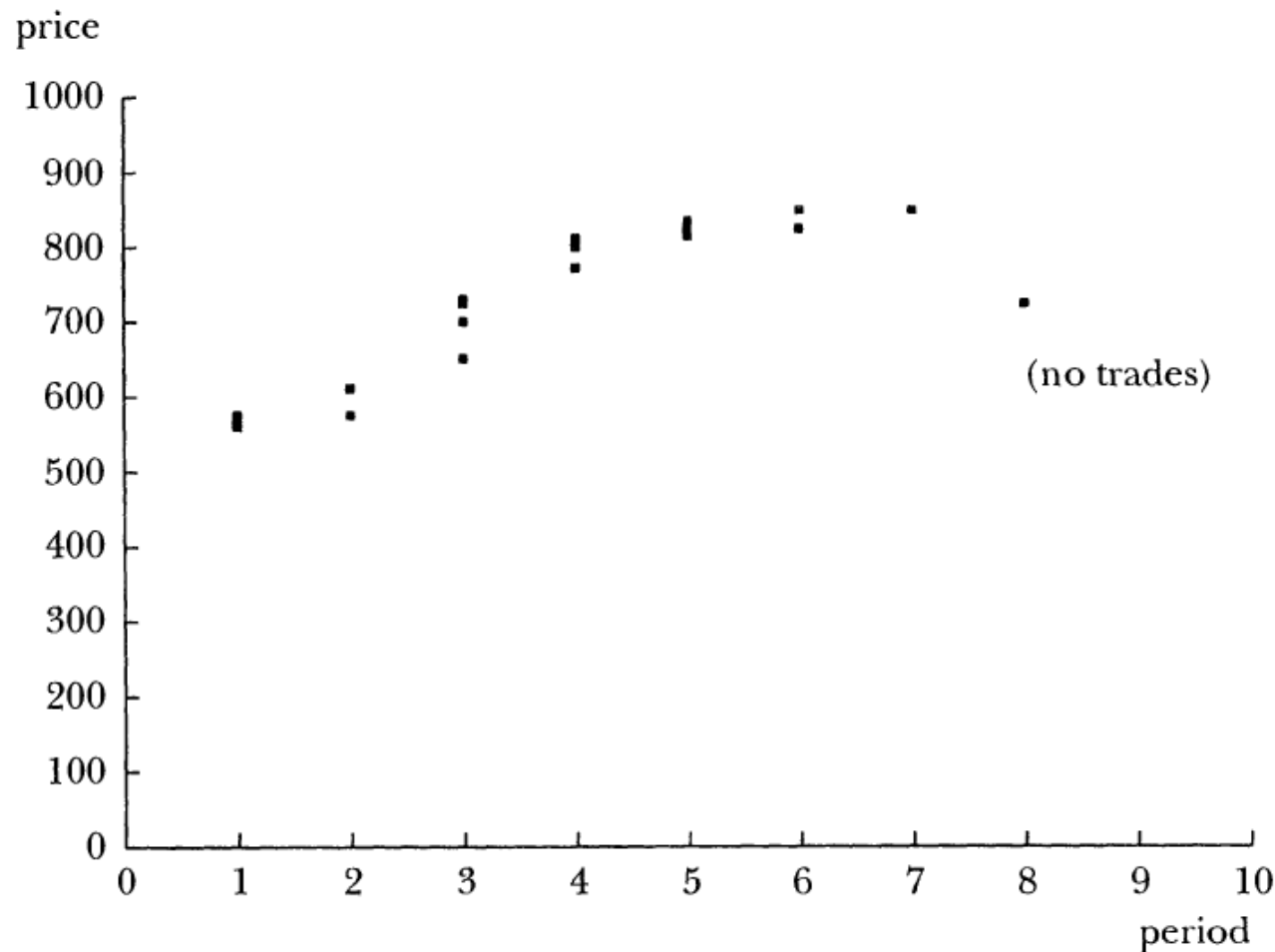
Asset 4



Experiment conducted by Ball & Holt (1998)

Figure 1

A Price Bubble



The effects of experience: prices

DOUBLE-AUCTION MARKETS

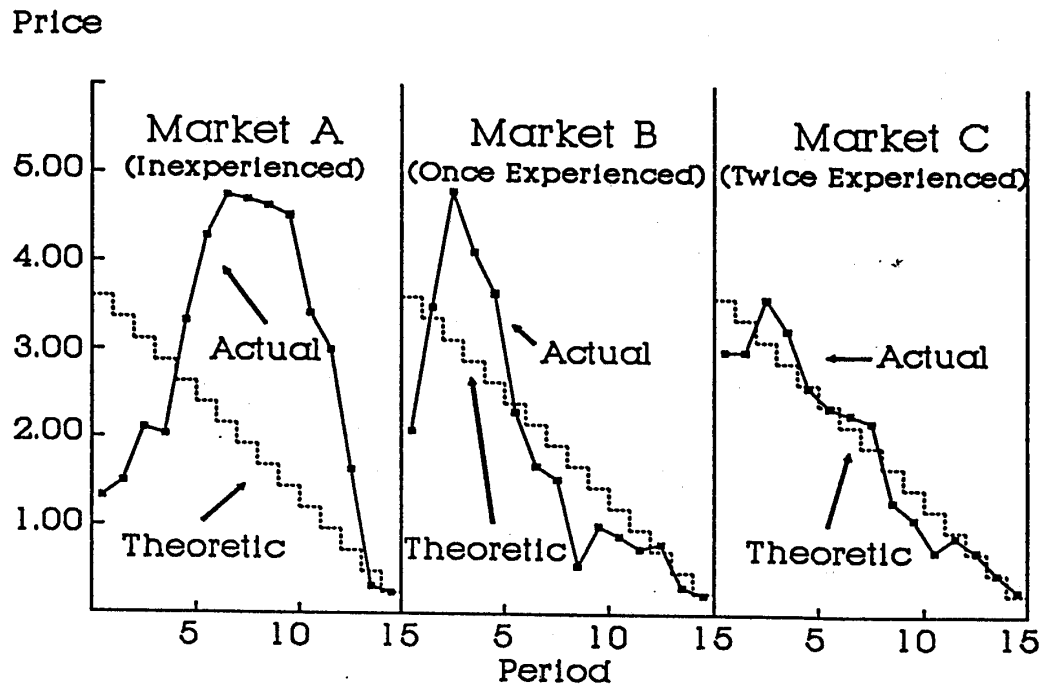


Figure 3.16 Intrinsic Value and Mean Prices in a Sequence of Three Double-Auction Asset Markets with the Same Participants (Source: Sessions 3pd295, 3pd296, and 3pd297, Peterson, 1991)

The effects of experience: trade

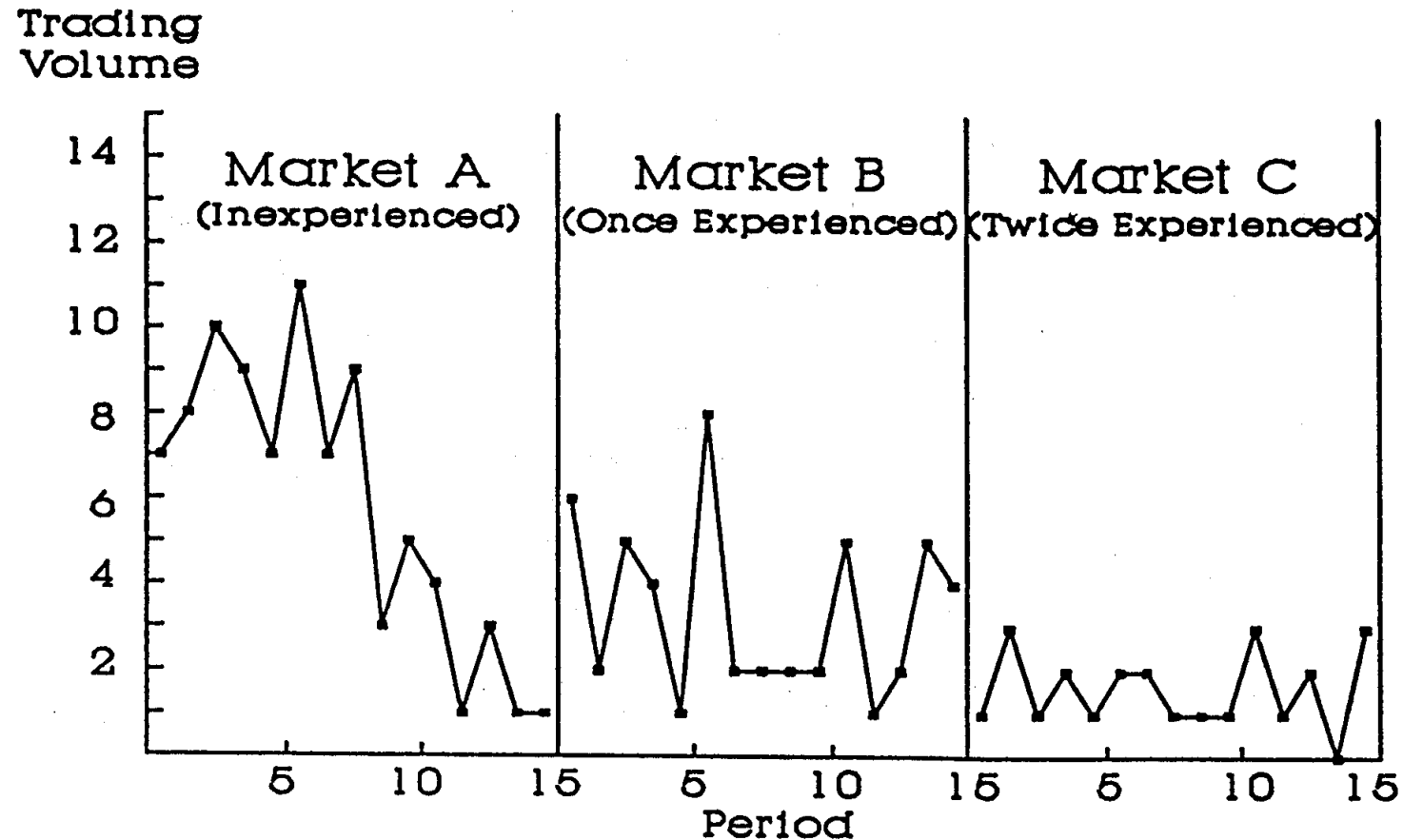


Figure 3.17 Transactions Quantities in a Repeated Series of Double-Auction Asset Markets (Source: Sessions 3pd295, 3pd296, and 3pd297, Peterson, 1991)

Bubbles and Crashes in Experiments

- Common pattern in experimental asset markets:
 - prices start out **below** fundamental value
 - then **bubble** develops, prices substantially **above** fundamental value
 - **crash** late in lifetime of asset
 - with **experience** bubbles get smaller, crashes happen earlier
 - eventually bubbles disappear and markets track fundamental value well
- Explanation:
 - uncertainty about behaviour of others, i.e. lack of common knowledge of rationality or decision errors, i.e. lack of rationality

Guessing game

- Take a piece of paper and write down your name and a number between 0 and 100. You can use up to 5 decimal places.
- I will
 - collect all the pieces of paper
 - calculate the average of all numbers
 - calculate $\frac{2}{3}$ of this average = **winning number**
- Whoever is closest to the winning number will receive £2.
 - If several people are equally close to the winning number, the £2 will be divided.

Guessing game: Prediction and results

- Prediction
 - Numbers > 67 are irrational
 - If no one chooses the numbers > 67 , then numbers > 45 are irrational.
 - ...
 - Only zero survives the iterated elimination of dominated strategies.
 - BUT: Was the winning number zero?
- Results
 - Average:
 - Winning number:
 - Number of people who chose zero:

Interpretation

- Lack of common knowledge of rationality
- If the others did not chose 0, it does not make sense to chose zero yourself.
- If everyone invests in a bubble, it can be profitable to bet on increasing prices even if prices are above the fundamental value.

Repetition of the guessing game

- Take a piece of paper and write down your name and a number between 0 and 100. You can use up to 5 decimal places.
- I will
 - collect all the pieces of paper
 - randomly pick 2 papers and calculate the average of these 2 numbers
 - calculate $\frac{2}{3}$ of this average = **winning number**
- Whoever is closest to the winning number will receive £2.
 - If both people are equally close to the winning number, the £2 will be divided.

The two-person beauty contest

(Grosskopf & Nagel, 2008)

- The lower number always wins
 - 0 is the (weakly) dominant strategy
 - Nevertheless, about 50% of people chose a number > 0
- Not only a lack of „common knowledge of rationality“
- „Rationality itself is missing (for some people)“

Remark

- Business professionals create the “same” speculative bubbles.
- This is an often cited result in “Behavioral Finance”.
- DA does not generate “rational” outcomes per se
- Possible interpretation: Absence of common knowledge of rationality renders speculation profitable even for rational traders. Even if everybody is rational but assumes the existence of some irrational traders the bubble can occur.
- *“It is not a case of choosing those [faces] that, to the best of one’s judgment, are really the prettiest, nor even those that average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practice the fourth, fifth and higher degrees.” (Keynes, General Theory of Employment Interest and Money, 1936).*

Bubbles and Crashes in Experiments

- Lei, Noussair, Plott (2001): asset market **without** resale
 - no **speculation** on errors of others possible, buying above fundamental value is dominated
 - nevertheless, >35% of transactions at price > max. possible dividend stream, typical bubbles and crash pattern
 - hence lack of rationality matters
 - possible reason for bubbles: excessive trading, since nothing else to do in experiment (**experimenter demand effect**)
 - treatment with simultaneous short-term market reduces excessive trading, but does not completely eliminate bubbles
- overall explanation of bubbles and crashes: irrational behaviour plus speculation on irrationality of others

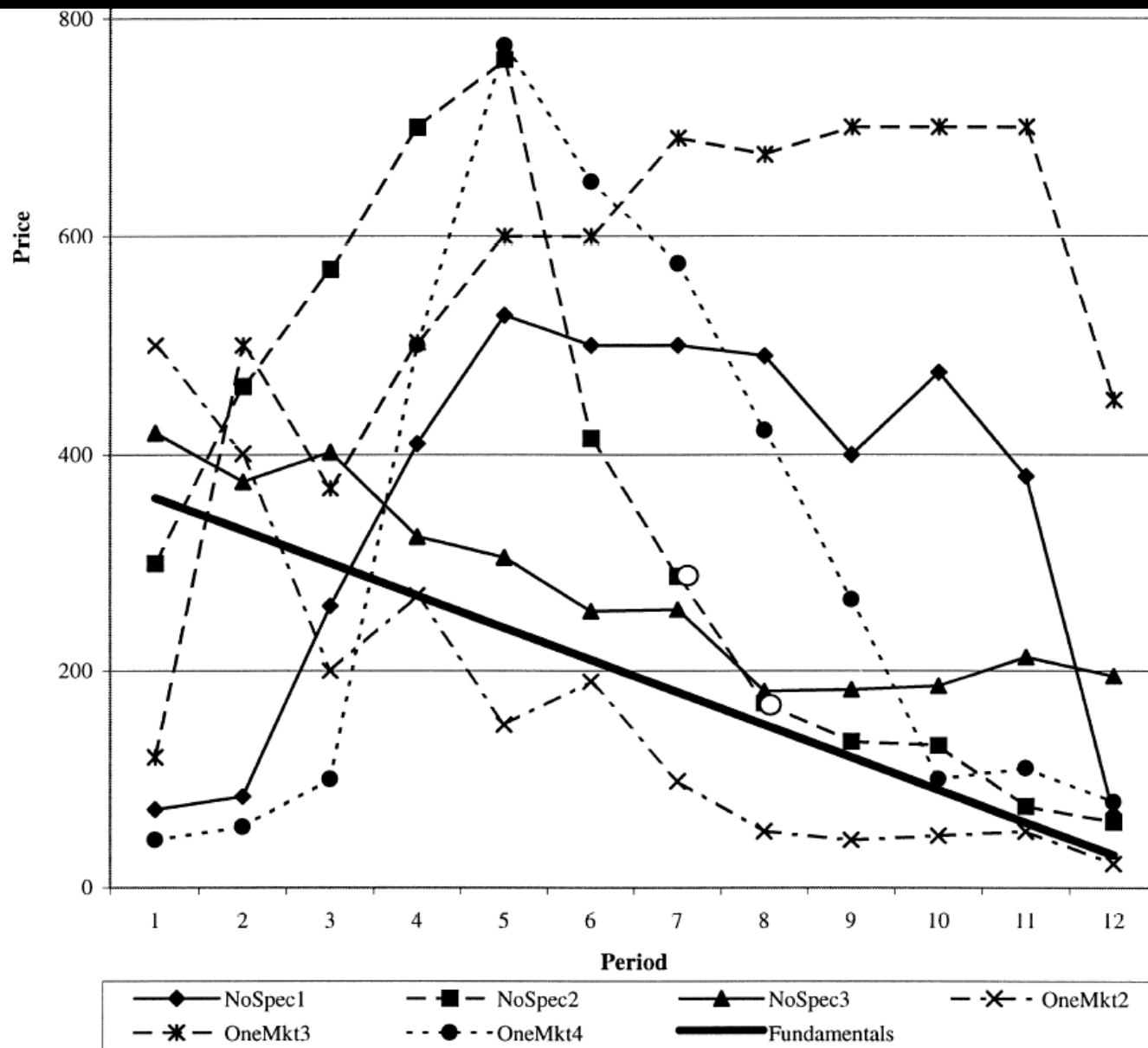


FIGURE 1.—Time series of median transaction prices by period: NoSpec and 12-Period OneMarket sessions.

Financial Markets Experiments

- Experiments also allow testing whether markets react **asymmetrically** to changes:
 - *“There’s an implicit judgment that the coefficients [of an econometric model of asset prices] work symmetrically on the upside and downside. I’m beginning to question whether that premise is true.”*
Alan Greenspan: Sept. 17, 2007.
 - *“Fear as a driver [of market behaviour], which is going on today, is far more potent than euphoria.”*
Alan Greenspan: Sept. 6, 2007.
- One interpretation of these comments is that markets react asymmetrically to changes in the variables that influence prices.

Inflationary and deflationary shocks

- Noussair, Richter, Tyran (2008):
 - asset market with **nominal shocks** without impact on real value
 - **inflationary** and **deflationary** shocks
 - **money illusion** might matter
 - **nominal loss aversion** (NLA): reluctance to sell at nominal loss
 - inflationary shock leads to higher nominal prices, so NLA does not matter
 - deflationary shock leads to smaller nominal prices, so NLA can matter

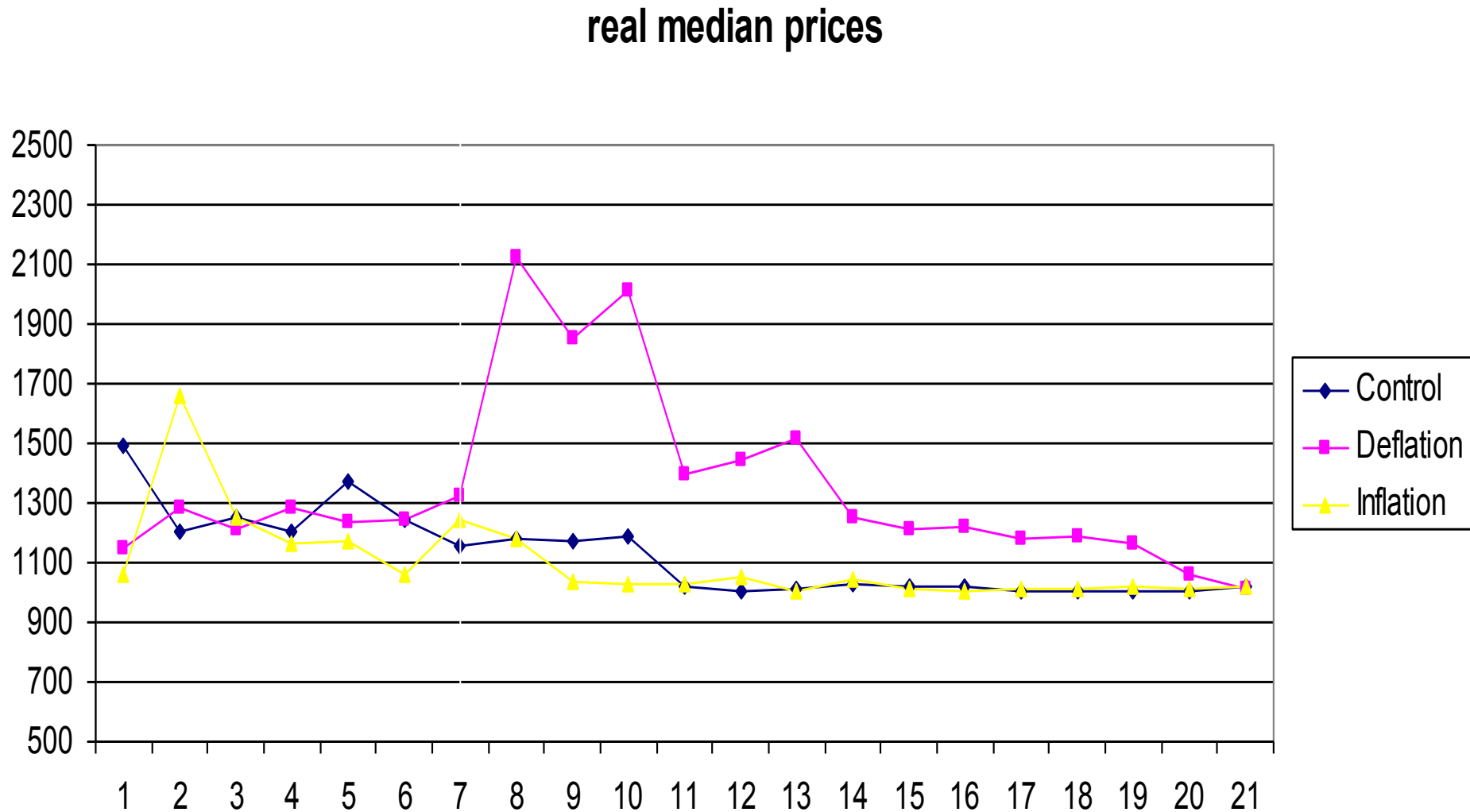
Noussair, Richter, Tyran (2008)

- Asset market with a life of 21 periods
- Fundamental value of the asset is **constant** over time:
 - after each period, asset pays dividend with expected value 0
 - terminal final buyout value of 10 DKK paid on each share at the end of period 21
- Initial endowment of each individual: 10 units of asset and 50 times fundamental value in cash
- 6-8 traders per market

Noussair, Richter, Tyran (2008)

- **Inflation treatment:**
 - Surprise nominal shock occurs after period 7
 - Shock changes no real variables
 - Dividend distribution, final buyout value, cash holdings, and conversion rate from ECU to DKK are all **multiplied** by 14
 - Nominal fundamental value is 1000 ECU before shock, 14000 ECU afterwards
- **Deflation treatment:**
 - Surprise nominal shock occurs after period 7
 - Dividend distribution, final buyout value, cash holdings, and conversion rate from ECU to DKK are all **divided** by 14
 - Nominal fundamental value decreases from 14000 to 1000 ECU
- **Control treatment:** No shock occurs
 - Nominal fundamental value equal to 1000

Noussair, Richter, Tyran (2008): Results



Noussair, Richter, Tyran (2008): Results

- **Result 1: Rapid adjustment to inflationary shock:** Real asset prices are unaffected by a nominal inflationary shock
- **Result 2: Asymmetry** between inflationary and deflationary shocks: Real asset prices are **increased** by a nominal **deflationary** shock (nominal prices fall, but not enough)
- **Result 3:** The effect is **temporary**, in final periods price close to fundamentals in all treatments
- **Possible explanation:** nominal loss aversion and traders might see buying a unit and then re-selling it as one action, so are unwilling to sell after deflationary shock at lower nominal price
 - but why do others buy at too high prices?
 - it might play a role that there is lots of cash in the market compared to number of units of the asset

Noussair, Richter, Tyran (2008)

- **Design issue: how to design surprises without deceiving subjects?**
- Initial instructions on trading in computerized market were read, then subjects practiced trading for 10 minutes
- After the practice periods, instructions describing the experimental environment were read.
 - These spelled out which variables were not subject to later change in the experiment, and which might be changed.
- After period 7, the experiment was halted.
 - New instructions were read explaining the changes in the environment.
 - The instructions indicated that no more changes to the environment would occur.

Further literature on bubbles

- The effect of the possibility of short selling
 - King, Smith, Williams, and Van Boening (1993) do not find any reduction of the bubble
 - Ackert, Charupat, Church, and Deaves (2002) find that bubbles almost disappear (short selling implemented better experimentally).
- Introduction of derivatives
 - Porter, and Smith (1995) find no reduction of the bubble with a derivative for period 8 price
 - Noussair, Charles, and Tucker (2003) find a reduction of the bubble with a derivative for each period.
- Active interest rate policy has barely any effect on the bubble.
 - Becker, Fischbacher, and Hens (2002)

Problem Set

1. Why can the expectation that others are not rational lead to bubbles if resale is allowed but not if resale is not allowed?
2. Some people argue that short-selling (i.e. selling assets one currently does not own and has to buy later) can stabilize markets because it undermines bubbles. Others argue that it can destabilise markets by accelerating crashes. Think of a design to test these competing hypotheses. What could be insightful treatments to get a better understanding?