The Economics of Money illusion

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Outline

• Introduction
  • Evidence
    • Surveys (Stephens and Tyran WP 2012)
    • Neuroscience
    • Field (labor, housing, stock markets)
    • Tyran (Science 2007), Fehr and Tyran (JEP 2005)

• Experiments
  • Fehr and Tyran (Games 2007): Long-run effects?
  • Fehr and Tyran (AER 2001): Nominal inertia?
  • Fehr and Tyran (ECMA 2008): Strategic properties?
  • Noussair, Richter and Tyran (JBF 2012): Asset market bubbles?

• Let’s start with an analogy
Which segment of the line is longer?
Framing (length)

(Müller-Lyer illusion, 1899)
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What is it?

- Thinking in money terms is salient, simple, natural and often a good heuristic
- People can overcome the “impulse” but it requires cognitive effort
- “rational expectations revolution” (no evidence, on “a priori” grounds)
Shafir, Tversky and Diamond (QJE 1997)
Evidence: Surveys

Shafir, Tversky, Diamond (1997, QJE)
• Questionnaire study
  • Example: 2% wage cut at no inflation is worse than 2% wage increase at 4% inflation
  • Interaction of loss aversion and nominal thinking
• Money Illusion as a framing effect
Tyran and Stephens (WP 2012)
Evidence: Surveys

- 732 respondents evaluate hypothetical housing transactions (internet experiment). 4 real scenarios framed as nominal loss or gain (8Qs). Example (real loss of 2%):
  - “Albert bought a house for kr. 2’000’000. Some years later he sells the house again.
  - Gain: In the period he owned the house, inflation was 11%, meaning that all prices increased by 11% during this period. Albert received kr. 2’175’600 for the house (i.e. 8.8 % more than he paid).
  - Loss: In the period he owned the house, inflation was 1%, meaning that all prices increased by 1% during this period. Albert received kr. 1’979’600 for the house (i.e. 1% less) than he paid).
  - How advantageous do you think this transaction was?” (Scale 1-15)
Tyran and Stephens (WP 2012)
Evidence: Surveys

- 73% of respondents have NLA > 0
- Lower NLA scores for those who think longer, have higher IQ and cognitive reflection scores

Index of NLA$_i$: response in gain frame – loss frame (averaged). NLA > 0: worse evaluation when nominal loss
"medial prefrontal cortex exhibits money illusion": earn money to shop from a catalogue. Treatments: Low vs. high (money earned and prices are 50% higher)

mPFC has been associated with processing of rewards

Money illusion as measured in the mPFC is correlated with questionnaires

Advantage: Money illusion is directly observed

Limitation: no interaction

Weber, Rangel, Wibral and Falk (PNAS 2009)
Evidence: Neuroeconomics
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Evidence: Field studies

- Labor Markets
  - Fehr and Goette (JME 2005)

- Low inflation rates are costly (because nom. wages cannot adjust to sectoral shocks)
- Asymmetric real effects of monetary policy: large with contraction, small with expansion
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Evidence: Field studies

• **Housing markets**
  • Genesove and Mayer (QJE 2001)
  • Brunnermeier and Juillard (RFS 2008)

• **Asset markets**
  • Modigliani and Cohn (Fin.Analyst 1979), Cohen, Polk, Voulteenaho (QJE 2005), Schmeling and Schrimpf (EER 2011)

• **Limitation:** Can alternative explanations be ruled out?
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Experiments

• Lab Experiments
  • Fehr and Tyran (Games 2007): Long-run effects?
  • Fehr and Tyran (AER 2001): Nominal inertia? Asymmetry?
  • Fehr and Tyran (ECMA 2008): Strategic properties?
  • Noussair, Richter and Tyran (WP 2008): Asset market bubbles?

• Advantage: isolate causal factors due to experimental control

• Limitation: Did the experiment capture the important features of the “natural” economy?
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Experiments

• Intuition: Money illusion has
  • direct effects: bias, errors in optimization
  • indirect effects: people expecting that others make biased decisions react strategically

• Indirect effects are large if strategic complementarity prevails: “Incentive to follow the crowd”

• Indirect effects operate through expectations
Money illusion and Coordination failure (Fehr and Tyran, GEB 2007)

Basic idea of the design

Equilibrium selection problem

Idea: MI as a coordination device

Equilibria are *pareto-rankable*

A > C in *real* terms

but A < C in *nominal* terms

Money illusion may coordinate expectations on an inefficient equilibrium: *permanent* losses
Money illusion and Coordination failure (Fehr and Tyran, GEB 2007)

Experimental design

- Participants are in the role of firms, choose price from 1 to 30, indicate price expectation
- 30 periods, groups of $n = 5$ or $6$, in total 174 subjects
- 2 treatments: nominal vs. real representation of payoffs
- Feedback: real payoff, actual average price
All groups in NH converge to the inefficient equilibrium (C), all groups in RH to the efficient equilibrium (A).

Average profit in NH is about half of RH (53%)

- Money illusion: Coordination on inefficient equilibrium
Expectations in NH are much higher than in RH from the beginning. Prices track expectations very well. Most subjects choose best replies to expectations.
In individual decision making, most (82%) learn to overcome money illusion by the last period.

Money illusion and Coordination failure (Fehr and Tyran, GEB 2007)

Direct vs. indirect effects

- Direct or indirect effect?
- Idea: eliminate the need to form expectations by transforming game into individual optimization problem: treatments with computerized opponents

<table>
<thead>
<tr>
<th>NH</th>
<th>NC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equilibrium A</td>
<td>0.00</td>
</tr>
<tr>
<td>Equilibrium C</td>
<td>0.84</td>
</tr>
</tbody>
</table>

In individual decision making, most (82%) learn to overcome money illusion by the **last** period.

→ **Indirect** effect is important
Money illusion and nominal inertia (Fehr and Tyran, AER 2001)
Experimental Design

- Does money illusion cause nominal inertia?
  Fehr and Tyran (AER 2001)
- Main differences to Fehr and Tyran (GEB 2007):
- Game with a unique equilibrium
- Monetary shock
- Payoff functions are homogenous of degree 0
- Negative shock
- No exogenous frictions whatsoever
Money illusion and nominal inertia (Fehr and Tyran, AER 2001)

Intuition

![Graph showing your price vs. average price of others, with a 45-degree line and a unique equilibrium point.](image-url)
Money illusion and nominal inertia (Fehr and Tyran, AER 2001)

Intuition

If common knowledge of rationality: immediate adjustment to C

Your price

Average price of others

45-degree line

C

A
Money illusion and nominal inertia (Fehr and Tyran, AER 2001)

Intuition

If common knowledge of rationality: immediate adjustment to C

If expectations are sticky: nominal inertia
Money illusion and nominal inertia (Fehr and Tyran, AER 2001)

Average nominal prices

Source: Fehr and Tyran (AER, 2001)
Money illusion and nominal inertia (Fehr and Tyran, AER 2001)

Expectations

Why are nominal prices sticky?
• Nominal frame induces sticky expectations
• Why are expectations sticky? Nominal loss aversion
• Test: positive shock
• We find strong asymmetry: quick adjustment of prices after positive shock

![Figure 2. Evolution of Average Expectations](image)
Money illusion and nominal inertia (Fehr and Tyran, ECMA 2008)
Complements vs. Substitutes

**Does strategic complementarity cause nominal inertia?**

Idea:

- Strategic complements: rational players have an incentive to imitate irrational players → multiply
- Strategic substitutes: rational players have an incentive to compensate the behavior of irrational players → mitigate
- Same procedures as with “negative shock”.
- Treatments:
  Change slope of reaction function (ceteris-paribus variation)
Money illusion and nominal inertia (Fehr and Tyran, ECMA 2008)

Nominal average prices

- Complements (NH)
- Substitutes (NH)
How relevant are strategic complements?

- Pricing in oligopolistic markets
- Pricing in asset markets can be characterized by endogenous complementarity ("momentum")
- Complementarity between wages and prices
  - Neg. shock $\rightarrow$ nominal wages fall little $\rightarrow$ nominal prices fall little $\rightarrow$ nominal wages fall little
Noussair, Richter and Tyran (JBF 2012)
Money illusion and asset market bubbles

- Effect of money illusion in an asset market? (double auction)
- Market with constant fundamental value. Dividend-bearing asset has $E(D) = 0$ in all periods
- Participants are endowed with 5 units of the asset and cash worth DKK 250 each but everything (except for the terminal value of the asset, 10 DKK) was denoted in “ECU”
- After some periods, we implement a purely nominal shock, by re-scaling all nominal values by $k$. If $k > 1$: “inflation”, if $k < 1$: “deflation” (and control with $k = 1$)
Noussair, Richter and Tyran (JBF 2012)
Money illusion and asset market bubbles

- Pre-shock phase: Markets bubble, but **independent** of level of nominal value: no “numerosity” effect
- real price = nominal price / $k$

![Graph showing real average price of median market over time with control, deflation, and inflation scenarios](image-url)
Post-shock phase: Deflation: bubble is exacerbated: money illusion affects bubbles
Our explanation: nominal loss aversion
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Conclusions

• Money illusion
  • Thinking in nominal values is natural, salient. It is an “impulse” like optical illusions, is common (in surveys) and can be measured in the reward system of the brain, but can be avoided with cognitive effort
  • Money illusion interacts with loss aversion: nominal losses are more salient
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Conclusions

- Experimental evidence
  - Can have long-term effects by coordinating agents on bad equilibrium
  - Asymmetric effects: Strong nominal inertia after negative monetary shock, little effect after positive
  - Money illusion shapes expectations formation
  - Almost no inertia with S. Substitutes
  - Asset market bubble not affected by level of nominal scale but is affected by change of scale (nominal loss aversion)

Together with field evidence from labor, real estate and asset markets, this suggests that money illusion belongs on economists’ research agenda
The organizer’s question

• Can economics as a scientific discipline benefit from concepts, methods and insights developed in other disciplines, notably the natural sciences?
• Yes
• Incorporate concepts & insights from psychology: Loss aversion, (money) illusion/perception, cognition
• Adapt methods from social science (surveys) and from natural science: neuroeconomic, experimental