Money Illusion

"An economist can, of course, commit no greater crime than to assume money illusion." (J. Tobin)

Structure
• Literature
• What is money illusion?
• Why is MI interesting?
• A brief history of the idea
• A simple model
• Empirical evidence

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Literature

• Central Paper
  – Fehr, Ernst and Jean-Robert Tyran (2004): *Money Illusion and Coordination Failure.* CESifo WP no. 1141.

• Basic Papers:
  – Fehr, Ernst and Jean-Robert Tyran (2001): *Does Money Illusion Matter?* AER 91(5).
  – Shafir, Eldar; Peter Diamond and Amos Tversky (1997): *Money Illusion.* QJE 112(2).
  – Fisher, Irving (1928): *The Money Illusion.* Adelphi Company, New York.

What is Money Illusion?

• *Patinkin (1965):* "An individual will be said to be suffering from such an illusion if his excess-demand functions for commodities do *not* depend solely on relative prices and real wealth".

• *Shafir et al. (1997)* interpret "money illusion as a bias in the assessment of the real value of economic transactions, induced by a nominal evaluation."

• *Fehr and Tyran (2004):* MI occurs if „objectively identical situations cause different behavioral patterns depending on wether the situation is framed in nominal or in real terms."

What is Money Illusion?

In one word:

Money illusion is not only about (computational and expectational) *mistakes in discounting*, but always plays a role when *nominal representations mislead to wrong decisions and inefficient equilibria.*

This can happen in inflationary frames as well as in decision frames with constant prices.

7 points why is MI interesting

1. The question whether (nominal) money has any real effects has a long tradition in economics (e.g. *Blanchard (1990)* as an overview); MI could finally be accepted as a channel, because…
   …we observe for example
   • that *prices and wages are sticky* (e.g. Akerlof, 2002; Blinder et al., 1998)
   • that *indexing* does not occur in contracts and laws as theory would predict (e.g. Joskow, 1988; Leijonhufvud, 1977)
   • casually that the public and the media often show *confusion* about real and nominal worth of money (examples in *Shafir et al., 1997*)

7 points why is MI interesting

2. Alternative representations of the same situation can lead to different responses *(Selten and Berg, 1970; Tversky and Kahneman, 1981)*

   Example *(Kahneman and Tversky, 1979, 1991):* Choice between
   1. secure total wealth of 250$ and a chance of total wealth of 240$ or 265$ or
   2. status quo (250$) and a loss of 10$ or a gain of 15$.
   Result: in terms of final wealth people tend to prefer the chance; in terms of gains and losses the status quo is preferred.

3. Interaction with decision factors such as anchoring (Fischer and Modigliani, 1986), risk attitudes or fairness concerns *(Shafir et al., 1997)*

7 points why is MI interesting

4. Influence on the coordinative behavior of agents *(e.g. currency changeovers: Adriani et al., 2003)*

5. Equilibrium selection principles : payoff/risk dominance *(e.g. Harsanyi and Selten, 1988; Camerer, 2003)*

6. Small amounts of individual-level irrationality can have large effects *(e.g Akerlof and Yellen, 1985; Haltiwanger and Waldman, 1985,1989)*

7. Empirical evidence, but no theoretical foundation *(Shafir et al., 1997; Fehr and Tyran, 2001, 2004)*

A short history of the idea

Fisher (1928) observes the inability to discount correctly.

His **historical definition:**
MI is "the failure to perceive that the dollar, or any other unit of money, expands or shrinks in value."

But what about the **gold standard?**

"If we were to define a dollar as a dozen eggs, thenceforth the price of eggs would necessarily and always be a dollar a dozen. Nevertheless, the supply and demand of eggs would keep on working. For instance, if the hens failed to lay, the price of eggs would not rise but the price of almost everything else would fall. One egg would buy more than before. Yet, because of the Money Illusion, we would not even suspect the hens of causing low prices and hard times."

A short history of the idea

- *Leontieff (1936)* formulates the *homogeneity postulate* as reaction to Keynes about the "orthodox" classical scheme.
- *Friedman and the Monetarists:* Direct effects on aggregate spending to monetary impulses
- *Lucas in "Expectations and the Neutrality of Money" (1972):* Micro-based GE model with rational expectations, but without any form of MI => Lucas' model achieves monetary neutrality and a theoretical Phillips curve as basic features.
- Recent Research: Empirical investigation more than theoretical one.
  Shafir et al. (1997), provide questionnaire evidence; *Fehr and Tyran (2001, 2004)* try to prove MI through experiments.

What is Money Illusion?

1. **Individual-level Money Illusion**

   If an agent solves an individual maximization problem more correctly in real than in nominal terms, we observe *individual-level MI (framing or representation effect) (Fehr and Tyran, 2004).*
- People tend to use the frame which is more salient, simple or "natural" (in economics the nominal one).
- They entertain multiple representations contemporaneously *(Shafir et al., 1997)*
- Nominal price anchors can play a role *(Shafir et al., 1997).*
- → *"[…] this bias is likely to depend on several factors, notably the relative salience of the nominal and real representations, and the sophistication and experience of the decision maker."*

What is Money Illusion?

2. **Money Illusion at the Aggregate Level**

   If „in an interactive situation the failure of some agents to fully adjust to the nominal shock will, in general, provide incentives for other agents to not fully adjust to the shock," we speak of *MI at the aggregate level* (snowball effect) *(Fehr and Tyran 2001).*

A simple model

- Fehr and Tyran (2001), based on a monopolistically competitive economy model (Akerlof and Yellen 1985; Blanchard and Kiyotaki 1987)
- Focus on firms: max real profits

$$\Pi_i = \Pi_i\left(\frac{P_i}{\bar{P}}, \frac{M}{\bar{P}}\right)$$

- with
  - Π_i firm i's real profit
  - P_i nominal price set by firm i
  - $\bar{P}$ aggregate price level
  - M money supply

A simple model

- $Y \sim \frac{M}{P}$ real aggregate demand
- PMP $\implies$ symmetric Cournot solution

$$P_i^*(P_j) = P_i^* = P_j^* \quad \forall i, j$$

- Assume Π_i to be homogenous of degree zero in $P_i, \overline{P}, M$; then a monetary shock $\lambda \neq 0$ leads to the new equilibrium

$$\lambda M, \lambda P_i^*, \lambda \overline{P}^*$$

A simple model

- Assume there are two groups who know each other in advance:
  1. A small group 1 suffers from MI ε:
     no full adjustment: $P_1^* = \lambda P_i^* - \varepsilon \approx P_i^*$
  2. Group 2 reacts fully rational, anticipating P_1^*:

  $$P_2^*(P_1^*) = P_2^*(\lambda P_i^* - \varepsilon) = \lambda P_i^* - \eta$$

- **Intermediate Result:** Money is not longer neutral and both groups choose a Pareto-inferior equilibrium.

A simple model

- Assume *strategic complementary*, i.e. there exists a positive relationship between P_i^* and the aggregate price level $\overline{P}^*$.
- Then group 2 has an incentive to *imitate* group 1 and sets η s.t. $P_2^* \approx P_1^*$, too.

- **Result:** The existence of a small group of irrational subjects has a large effect on the aggregate price level and the equilibrium adjustment process *(Haltiwanger and Waldman, 1989).*

Empirical Evidence:
Fehr and Tyran (2004)

- Based on *Fehr, Ernst and Jean-Robert Tyran (2004): Money Illusion and Coordination Failure. CESifo WP no. 1141.*
- Carried out an *experiment under laboratory conditions,* since there is hardly any field data in MI issue availiable.

- The ***aim*** was to study
  - Extent of individual-level MI on the one hand (microeconomic view)
  - Effect of potential MI on market coordination on the other hand (macroeconomic view)
- The behavioral differences across real and nominal representations capture the overall effect of MI.

Empirical Evidence:
Experimental Design

- Experimental design: a symmetric strategic n-player pricing game with three Pareto-ranked equilibria
- Each subject chooses a price $P_i \in \{1,2,...,30\}$ and gets a payoff, where the real payoff depends only on the suject's on price and the average price $\overline{P}_{-i}$ of all the other players.
- The payoff was presented in a simple 30x30 payoff matrix.

- Since the game is symmetric, there exist one (real) Pareto-efficient equilibrium A with the highest real payoff, but two (nominal) Pareto-inferior equilibria B and C in the $(P_i, \overline{P}_{-i})$-space.

Empirical Evidence:
Nominal Payoff table

Equilibrium A:112
Equilibrium B: 50
Equilibrium C: 567

Empirical Evidence: Real Payoff table

Equilibrium A:28

Equilibrium B: 5

Equilibrium C: 21

Empirical Evidence: Experimental Design

- Four **treatment conditions** were designed, depending on the **type of representation** (nominal or real) and the **type of opponents** (human or computers).

- With computer opponents all strategic uncertainty is erased and subjects turn to become Stackelberg-leaders who have to solve an individual optimization problem.
False solutions point to individual-level MI then.

- The comparison of nominal treatment facing computers and facing human opponents shows the extent to which MI causes coordination failure in addition to individual-level MI.

- To be able to build up a best strategy, the game was repeated 30 times, and subjects were informed about their own real payoff and $\overline{P}_{-i}$ in each period.
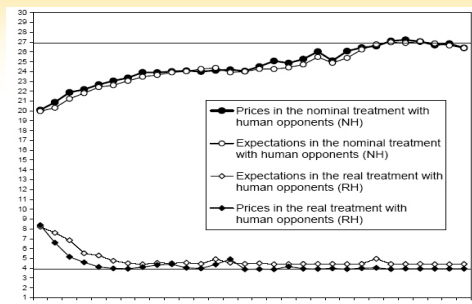
Empirical Evidence: Experimental Design

Experimental Design	Payoff representation in real terms	Payoff representation in nominal terms
Human opponents	RH	NH
Pre-programmed computers	RC	NC

Empirical Evidence: Four main results

1. **In the NH treatment most subjects converge to the inefficient equilibrium C, whereas almost all subjects choose the efficient equilibrium A in the RH treatment.**

→ MI has powerful effects on equilibrium selection.

→ Nominal frames cause higher expectations.

→ The expected price $\overline{P}_{-i}$ is a decisive determinant of the subjects' price choice; does the higher expectation (i.e. the belief that all others suffer from MI) cause the inefficient choice or is individual MI the key?

Empirical Evidence:
Average prices and expectations in human opponent treatments

- Prices in the nominal treatment with human opponents (NH)
- Expectations in the nominal treatment with human opponents (NH)
- Expectations in the real treatment with human opponents (RH)
- Prices in the real treatment with human opponents (RH)

Empirical Evidence: Four main results

2. **In the NC treatment, only a minority initially plays the efficient equilibrium A, whereas the most play A from the beginning in the RC treatment.**
Yet, learning effects in the NC can be observed.

→ The nominal representation causes problems for the single subjects to solve his individual optimization problem; this provides evidence for individual-level MI.

→ Learning could be the solution, but: strategic interaction could magnify a small group's MI to large aggregate effects (see small model).

Empirical Evidence:
Average prices across all treatments
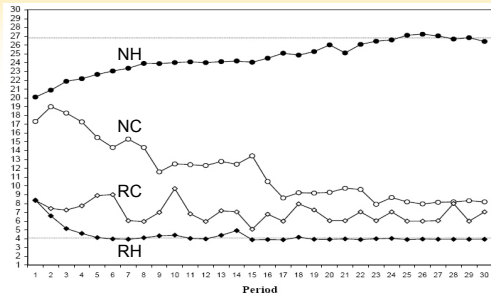
Empirical Evidence:
Four main results

3. ***Compared to RC, the strategic interaction in the RH treatment increases the frequency with which A is played, and seems to remove almost all inefficiencies.***

→ The difference between RH and RC indicates that there is a small amount of individual irrationality when solving the maximization problem even in the RC treatment.

→ Strategic interaction with human players seems to remove this individual-level bounded rationality.

→ Possible explanation: *Imitation* of the other players enhances adjustment.

Empirical Evidence:
Four main results

4. ***Compared to NC, strategic interaction in the NH treatment causes an increase in the frequency with which the inefficient equilibrium C is played; the play of A is eliminated from the beginning.***

→ Subjects learn to choose A in the NC treatment, whereas human opponents seem to attract each other to the inefficient equilibrium via MI forever.

→ Learning opportunities in the NC seem to help to raise the veil of money and reach A if people are not entrapped in the attraction power of an inefficient equilibrium by others.

Implications for Economics
and the Economy

- Existence of *Pareto-inferior equilibria* or *disequilibria*
- *Coordination failures (Fehr and Tyran, 2004)*
- *Earnings*: When people do not think in purely economic terms, nominal frames could have a great influence (Shafir et al., 1997)
- *Transactions*: "Higher nominal prices – although real prices had not changed – were conducive to selling and aversive to buying." (Shafir et al. 1997)
- *Contracts (Shafir et al. 1997)*:
  – alternative framings play a role
  – *"frame-dependent risk aversion"*
- People's intuitive accounting is often based on multiple representations *(Shafir et al. 1997)*.

Implications for Economics
and the Economy

- *Investment* (Shafir et al., 1997)*:*
  – People showed much less risk aversion in an 10%-inflation context because of the high nominal returns compared to a non-inflationary frame.
  – Loss aversion occurs relative to some nominal reference point.
- Individual decision making (anchoring effects) (Shafir et al., 1997).
- Nominal payoff dominance: High nominal payoffs may be focal points with strong attraction power in equilibrium selection (Fehr and Tyran, 2004)
- MI enters into the *perception of fairness and worker morale* (Shafir et al., 1997).