

# Behavioral Macroeconomics: Part 3 - Money Illusion

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# Money Illusion

Shafir, Diamond and Tversky (QJE 1997)

- Tendency to think in terms of nominal rather than real monetary values
- Patinkin (1965): Any deviation from 'real' decision making
- The long-run neutrality proposition of the quantity theory of money - absence of money illusion
- Fehr and Tyran 2001: Illusion-free world: objective function of individual only depends on real and not nominal magnitudes. Purely nominal changes do not affect their opportunity set.
- Even Fisher (1928) believed, that money illusion is an issue

# Evidence for Failure

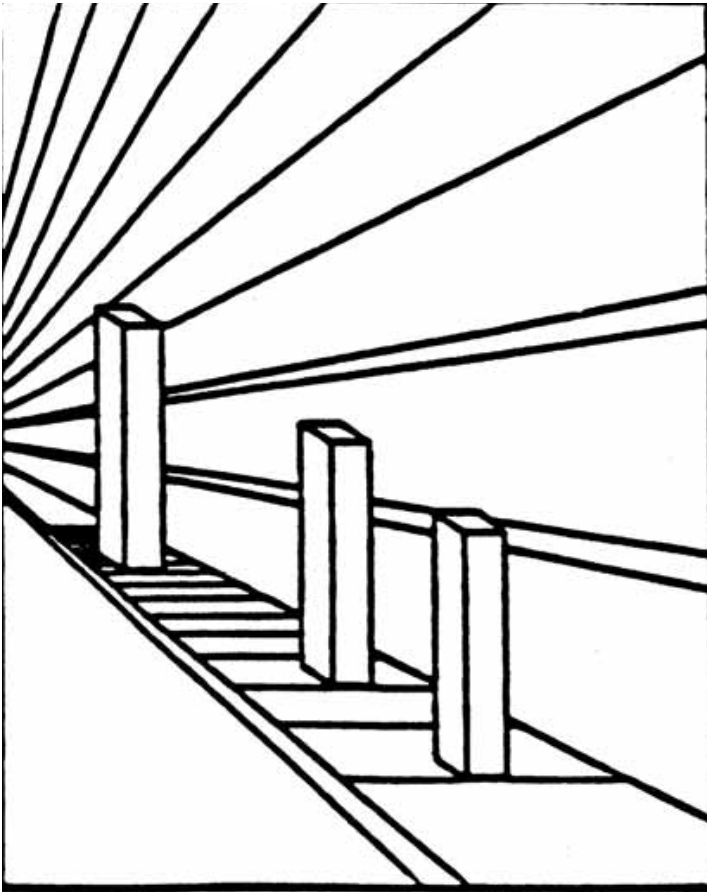
Three classes of anomalous observations (see also Howitt, New Palgrave Dictionary of Economics, 1987, 3:518-519)

- Prices (and also wages) are sticky
- Indexing does not occur as often as theory would predict
- Conversation among people - think of newspaper articles etc.

# Indexing

- Possibility to index contracts, traded assets etc.
- Empirical evidence suggests: only slow introduction of indexed contracts when inflation picks up
- Observed partial disappearance of indexed contracts when inflation slows down
- Example:
  - Inflation  $\uparrow$  - wealth distribution from borrower to debtor
  - Inflation  $\downarrow$  - wealth distribution vice versa

# Illusion Blocks



# Experimental Studies

Show that not only individuals are prone to money illusion, but they believe that other people's behavior is affected by money illusion. So, by this indirect effect, even if on the individual basis money illusion is small, great impact on aggregate demand/supply etc. possible (see Fehr and Tyran (2001)).

# Money Illusion in Wages

- In the Solow model: effort a function of real wage:  $e(w/s)$ , where  $w$  is the nominal wage and  $s$  output and consumption price
- Profits of the firm are thus  $sF(e(w/s)L) - wL$
- First order conditions for  $L$  and  $w$ :

$$sF'e = w \quad (1)$$

$$F'e' = 1 \quad (2)$$

- These yield:

$$\frac{(w/s)e'(w/s)}{e(w/s)} = 1 \quad (3)$$

# Money Illusion in Wages (continued)

- Effort depends now on real wage and ratio of current nominal wage to previous one:  $e(w/s, n)$ , where  $n = w/w(-1)$
- Profits of the firm are thus  $sF(e(w/s, w/w(-1)))L - wL$
- First order conditions for  $L$  and  $w$ :

$$sF'e = w \quad (4)$$

$$sF' \left[ \frac{e_w}{s} + \frac{e_n}{w(-1)} \right] = 1 \quad (5)$$

- These yield:

$$\frac{w}{e} \left[ \frac{e_w}{s} + \frac{e_n}{w(-1)} \right] = 1 \quad (6)$$

# Explanation for Nominal Inertia

- Informational frictions
- Staggering of contracts
- Cost of price adjustment
- Near-rationality
- Fehr and Tyran (2001): Money illusion could provide an explanation for the inertia of nominal prices and wages and, hence, for the nonneutrality of money.

# Summary

- Direct and indirect effects of money illusion major determinants of long-lasting nominal inertia
- After fully anticipated negative nominal shock long-lasting nominal inertia
- After fully anticipated positive nominal shock less nominal inertia
- People taking as rule of thumb nominal payoffs as a proxy for real payoffs
- Negative money shock  $\rightarrow$  nominal payoffs  $\downarrow$  since prices  $\downarrow$
- Positive money shock  $\rightarrow$  nominal payoffs  $\uparrow$  since prices  $\uparrow$
- If nominal payoffs taken as proxy for real payoffs, more reluctance of adjusting prices after negative nominal shock

# Direct and Indirect Effects

- Direct: direct results of individual optimization mistakes
- Indirect: arise because some agents expect others to be prone to money illusion and as a consequence they behave differently

# Money Illusion at the Aggregate Level

- In equilibrium no persistence of money illusion, though influence on the adjustment process after fully anticipated monetary shock

# The Model

- Firm's behavior (monopolistic competition):

$$\pi_i = \pi_i(P_i/\bar{P}, M/\bar{P}), \quad \text{for } i = 1, \dots, n. \quad (7)$$

where  $\pi_i$  is firm  $i$ 's real profit,  $P_i$  nominal price set by firm  $i$ ,  $\bar{P}$  aggregate price level,  $M$  supply of money,  $n$  number of firms.

- $M/\bar{P}$  proportional to real aggregate demand
- In equilibrium each firm  $P_i^* = \bar{P}^*$
- Change in  $M$  to  $\lambda M \rightarrow \lambda P_i^*$  and  $\lambda \bar{P}^*$

# The Model Continued

Suppose: one group of agents that suffers from money illusion and does not fully adjust nominal prices according to the above rule

- The second group anticipates behavior of first group. Anticipates a change in real aggregate demand  $M/\bar{P}$ , they also do not adjust their prices to  $\lambda P_i^*$
- Monopolistic competition and strategic complementarity  
→  $P_i$  positively related to  $\bar{P}$  → firms incentive to partly imitate the behavior of nonrational firms → so the latter disproportional large impact on aggregate price level

# Experimental Design

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	Payoffs in Real Terms	Payoffs in Nominal Terms
Computerized opponents	Real treatment with computerized opponents (RC): 22 groups with 1 human and $n - 1$ computerized players in each group	Nominal treatment with computerized opponents (NC): 24 groups with 1 human and $n - 1$ computerized players in each group
Human opponents	Real treatment with human opponents (RH): 10 groups with $n$ human players in each group	Nominal treatment with human opponents (NH): 11 groups with $n$ human players in each group

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- **Treatment C**: subject is informed about aggregate response rule of the computers
- **Treatment H**: coordination problem, task of forming expectations about the other players' price choices. Also guess about other players' money illusion affection.

# Expectations of Different Treatments

- **RC**: money illusion ruled out at individual and hence aggregate level. Slow price adjustment  $\rightarrow$  other individual-level irrationalities than money illusion
- **NC**: comparing RC with NC  $\rightarrow$  test whether money illusion does exist at individual level
- **RH**: individual-level irrationality other than money illusion possible, difference between RC and RH measures impact of coordination problem
- **NH**: coordination problem as in RH; comparison with RH, isolation of total effects of money illusion. Total since direct effects of individual-level money illusion as in NC, plus indirect 'multiplier' effects

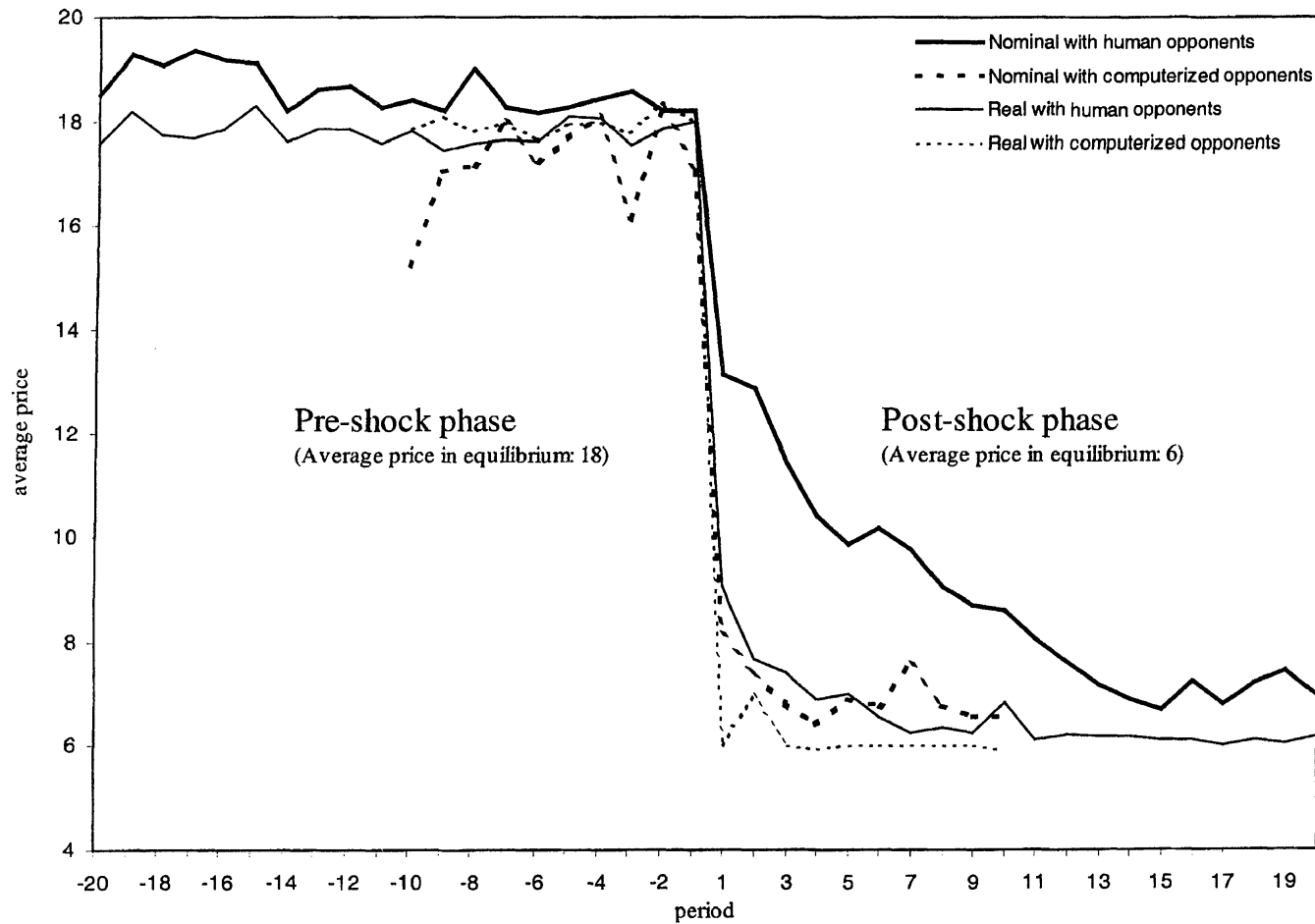
# Summary

- $\Delta P^{NC} - \Delta P^{RC}$  measures the aggregate impact of individual-level money illusion on nominal inertia. Note,  $\Delta P^{NC} - \Delta P^{RC} = P^{NC} - P^{RC}$ .
- $\Delta P^{NH} - \Delta P^{RH} = P^{NH} - P^{RH}$  measures total effects of money illusion (individual-level effects plus the indirect effects).
- If indirect effects exist:  $P^{NH} - P^{RH} > P^{NC} - P^{RC}$ , otherwise equality.

# Evolution of Prices and Efficiency Losses Over Time

Period	Average Price				Average Efficiency Loss (Percent)			
	Computerized opponents		Human opponents		Computerized opponents		Human opponents	
	Real (RC)	Nominal (NC)	Real (RH)	Nominal (NH)	Real (RC)	Nominal (NC)	Real (RH)	Nominal (NH)
-20			17.6	18.5			14.4	19.0
-19			18.2	19.3			21.5	14.6
-18			17.8	19.1			14.1	10.2
-17			17.7	19.4			9.5	11.7
-16			17.9	19.2			8.8	6.8
-15			18.3	19.1			10.8	13.2
-14			17.6	18.2			8.0	9.9
-13			17.9	18.6			8.2	4.2
-12			17.9	18.7			6.3	3.1
-11			17.6	18.3			5.5	7.5
-10	17.9	15.2	17.8	18.4	1.0	16.4	9.4	3.4
-9	18.1	17.0	17.5	18.2	0.5	12.6	3.6	1.6
-8	17.8	17.2	17.6	19.0	1.6	9.0	3.3	6.0
-7	18.0	18.0	17.7	18.3	0.5	3.0	2.4	1.8
-6	17.6	17.2	17.6	18.2	2.4	10.4	10.9	1.3
-5	18.0	17.7	18.1	18.3	0.3	5.4	7.0	2.7
-4	18.0	18.1	18.1	18.4	0.0	3.5	7.3	2.5
-3	17.8	16.1	17.6	18.6	1.3	12.6	3.7	2.8
-2	18.4	18.3	17.9	18.2	2.3	1.9	2.2	0.7
-1	18.0	17.0	18.0	18.2	0.0	5.3	0.9	0.9
1	6.0	8.1	9.1	13.1	0.0	10.4	51.8	65.1
2	7.0	7.4	7.7	12.9	3.6	8.2	20.0	47.5
3	6.0	6.8	7.4	11.4	0.0	4.4	15.0	34.8
4	6.0	6.4	6.9	10.4	0.6	6.5	9.1	27.4
5	6.0	6.9	7.0	9.9	0.0	8.0	14.8	17.4
6	6.0	6.8	6.6	10.2	0.0	15.6	7.7	15.9
7	6.0	7.5	6.3	9.7	0.0	9.3	4.5	16.4
8	6.0	6.8	6.4	9.1	0.0	15.5	4.6	10.7
9	6.0	6.5	6.3	8.7	0.0	4.3	3.8	9.5
10	5.9	6.5	6.8	8.6	1.6	3.8	11.0	13.8
11			6.1	8.1			4.6	8.2
12			6.2	7.6			3.3	6.4
13			6.2	7.2			2.1	6.2
14			6.2	6.9			2.8	4.6
15			6.1	6.7			2.6	2.6
16			6.1	7.3			2.1	9.6
17			6.0	6.8			0.9	5.2
18			6.1	7.2			1.8	14.2
19			6.1	7.5			1.4	12.5
20			6.2	7.0			3.0	2.4

# Evolution of Average Prices after Negative Shock



# Evolution of Average Prices after Positive Shock

- Rule of thumb: nominal payoffs proxy for real payoffs, therefore, we should observe that prices adjust more quickly after positive nominal money shock.

Period	Average Price		Average Efficiency Loss (Percent)	
	Real (RH)	Nominal (NH)	Real (RH)	Nominal (NH)
-15	13.0	14.9	14.7	26.3
-14	13.0	14.7	18.2	24.7
-13	12.7	14.6	10.7	20.7
-12	12.7	14.3	5.3	13.6
-11	12.7	14.3	6.1	20.5
-10	12.5	14.1	1.6	9.1
-9	12.5	13.6	2.1	10.9
-8	12.5	13.4	0.3	11.3
-7	12.4	13.7	1.2	14.8
-6	12.5	13.8	0.6	13.2
-5	12.5	13.8	1.6	8.4
-4	12.5	13.9	0.3	10.4
-3	12.5	13.6	0.9	7.0
-2	12.6	13.1	4.7	6.9
-1	12.5	13.1	1.9	1.0
1	22.5	20.5	22.3	24.0
2	24.3	22.8	3.9	7.2
3	24.8	24.1	1.2	4.2
4	24.9	24.8	0.7	1.4
5	25.0	25.0	0.2	0.9
6	25.0	25.1	0.1	0.3
7	25.0	25.2	0.1	0.4
8	25.0	25.1	0.1	0.1
9	25.0	25.0	0.1	0.1
10	25.0	25.2	0.1	0.3
11	25.0	25.2	0.2	0.1
12	25.0	25.0	0.1	0.1
13	25.0	25.0	0.1	0.1
14	24.3	24.5	6.3	5.9
15	24.6	24.9	4.0	1.4

# Conclusion

- Direct and indirect effects of money illusion cause nominal inertia
- Price sluggishness much smaller after positive shock than after a negative one
- Rule of thumb: nominal payoffs as proxy for real payoffs
- The coordination problem alone causes substantially less nominal inertia than money illusion. Also no asymmetric effect - RH: extent of nominal inertia very similar after positive and negative shock

# Extension to Wages

- Introduce workers as separate players
- If firms anticipate that workers will resist wage cuts after a negative money shock they will probably be reluctant to cut prices since this would reduce profits. If prices stay high, workers may feel justified in resisting wage cuts. Thus, reluctance to cut wages and prices could be mutually reinforcing.

# References

- [1] **Fehr, Ernst and Tyran, Jean-Robert (2001):** “Does Money Illusion Matter,” *American Economic Review*, 91, 1239-1262.
- [2] **Shafir, Eldar, Diamond, Peter and Tversky, Amos (1997):** “Money Illusion,” *Quarterly Journal of Economics*, 112, 341-374.