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Rational Agents and Economics Training: The Case of Money Illusion in Experimental Study

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Abstract: Economists have no hesitation in assuming that economic agents are rational. The general intuition is that economic decision affects real outcome that directly determines agent's well being in question. One such aspect of rationality, we often ascribe is that agents are free from money illusion indicating that agents are categorically caring about real magnitudes and not the nominal one. It is also argued that the problem of money illusion could be mitigated through learning and coordination among people. Money, thereby, theoretically, has no real effect in the long run. In this study, we attempt to investigate individual rationality in a sense, whether agents make decisions that are free from money illusion, particularly, when subjects possess a sufficient economics background. We use empirical data with subjects all studying M.Sc in Economics at the Copenhagen University. The experimental results show that even with such strong economics training subjects are individually prone to money illusion and even, at the aggregate level, locked in the Pareto inefficient outcome. Individual learning over time or coordination among people within the group could not lead them to correctly identify and obtain the rational decision at all.

Key words: Rational agents, money illusion, economics training, real payoff, nominal payoff, experimental study

INTRODUCTION

An economic theorist can of course, commit no greater crime than to assume money illusion (Tobin, 1972). Economists have no hesitation in deriving and explaining economic theories to presume that agents are rational and self-interested. The common intuition is that economic decision affects real outcome that directly determines agent's well being in question. Therefore, economic agents are expected to be careful enough to rationally choose the courses of action that maximizes welfare. One such aspect of rationality, we often ascribe is that agents are free from money illusion indicating that agents are categorically caring about real magnitudes and not the nominal one. Money, thereby has no real effect in the long run.

The rational expectations revolution in the 1970s provides further a solid ground to the economists not to invoke money illusion to explain the short-run non-neutrality of money. Accordingly, people are rational and since rational individuals do not exhibit illusions there is nothing to study. A powerful intuitive argument supports the view that money illusion is largely irrelevant for economics: the illusion has detrimental effects on peoples economic well-being and they have a strong incentive to make illusion free decisions. Therefore, people will ultimately make illusion free decisions, implying that money illusion has little or no impact on aggregate outcomes, at least in the long run. No doubt, the notion of agent's rationality, the intuition behind it is well convincing. But, if further, we consider that agents are heterogeneous, what is mostly likely being the case, then what about rationality? What about money illusion at the individual level and the aggregate level as well? What about its real effect, if any? More recently, however, some economists seem to be willing to reconsider the relevance of money illusion in economics, specially from the clear evidence that nominal wages and prices seem to be rigid (Akerlof, 2002; Bewley *et al*., 1999; Blinder *et al*., 1998; Campbell and Kamlani, 1997; Fehr and Tyran, 2001; Howitt, 2002; Kahn, 1997; Kahneman *et al*., 1986; Shafir *et al*., 1997). In this study, we attempt to investigate individual rationality in a sense, whether agents can make decisions that are free from money illusion, particularly when subjects possess a sufficient economics background. But before going to further discussion, we first need to explain what we mean and how do we interpret money illusion per SE.

Patinkin (1965) defined money illusion as any deviation from real decision making. Accordingly, 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.

Leontief (1936) defined money illusion as a violation of the homogeneity postulates. This intuition says that if the real incentive structure that is the objective situation,

an individual faces remains unchanged, the real decisions of an illusion-free individual do not change either. Two crucial assumptions underly this intuition: first, the objective function of the individual does not depend on nominal, but only on real magnitudes. Second, people perceive that purely nominal changes do not affect their opportunity set. For example, people have to understand that an equi-proportionate change in all nominal magnitudes leaves the real constraints unaffected. Whether people are in fact, able to pierce the veil of money, i.e., whether they understand that purely nominal changes leave their objective circumstances unchanged is an empirical question. For example, Irving (1928) was long days ago convinced that ordinary people are in general, prone to money illusion.

Thus, the absence of money illusion means that an individual's preferences, perceptions and hence, choices simply reflect real magnitudes and are not affected by purely nominal changes. From this viewpoint, an individual exhibits money illusion if his or her decisions depend on whether the same objective function is represented in nominal or real terms. There is a substantial experimental research that shows that alternative representations of the same situation may well lead to systematically different responses (Tversky and Kahneman, 1981; Fehr and Tyran, 2004). Representation effects seem to arise because people tend to adopt the particular frame that is presented and evaluate the options within this frame. For example, choice between risky prospects may be represented either in terms of gains and losses, which seems natural to most people or in terms of final assets, as recommended by normative theory. Money illusion in this context is a bias in the assessment of the real value of economic transactions, induced by a nominal evaluation (Shafir *et al*., 1997).

It is important to note that the nominal representation of an economic situation is probably the natural representation for most people (Fehr and Tyran, 2001). The nominal representation is simpler, more salient and often suffices for the short run (in the absence of hyperinflation), yet the representation in real terms is the one that captures the true value of transaction. People are generally aware that there is a difference between real and nominal values, but because at a single point in time or over a short period, money is a salient and natural unit, people often think of transactions in predominantly nominal terms. A basic form of money illusion thus, occurs when people take nominal values or changes as the proxy for real values or changes in real values, respectively (Fehr and Tyran, 2001).

A natural question that remains is whether money illusion still matters after people receive proper economics training. Economists generally assume that money illusion is an error that can be easily eradicated through learning specially some extent of economics training is quite enough. This study attempts to address this question whether a sufficient background in economics could eradicate money illusion at the individual level and whether coordination among those people in fact could eliminate such illusion over time.

The study based on the idea of preceding experimental researches by Fehr and Tyran (2001) in which subjects were of heterogeneous educational background followed by Wong (2005), who studied, whether introductory economics training could generate better illusion free decisions than the others. These studies show that agents with no or intermediate economics training are significantly affected by money illusion even after repeated periods of experiment and with group coordination. But, they did not study, whether a solid economics training could essentially leads the agents to correctly pierce the veil of money. This study attempts to fill this gap as we did the experiments with subjects all graduate (M.Sc) students in Economics, at the Copenhagen University, taking the study behavioral and experimental economics. Being a master student in economics and as a prerequisite to take the course behavioral and experimental economics the subjects are all expected to have a solid background in the major areas of economics like microeconomics, macroeconomics including game theory in general. The experimental results show that even with such strong economics training subjects are individually prone to money illusion and even at the aggregate level, locked in the Pareto inefficient outcome. Individual learning over time or coordination among people within the group could not lead them to correctly identify and obtain the rational decision at all.

Experimental set-up: The experiment is conducted in behavioral and experimental laboratory in department of economics, Copenhagen University. All subjects are master students in economics taking the course behavioural and experimental economics. Performance in the experiments are graded as a part of final examination, thereby subjects have strong incentive to go for the correct decision each time. Furthermore, taking part in the experiment is a mandatory for the course. Z-tree program is used to set up this experiment (Fischbacher, 1999). The experiment is based on a 30×30 payoff table, which has multiple Pareto-ranked equilibria. The experimental design

Table 1: Equlibria in the symmetric price-setting game

Equilibrium	Own price	Others average price	Nominal equilibrium payoff	Real equilibrium payoff	Comment
A	04	04	112	28	Pareto efficient equilibrium
B	05	06	162	27	No equilibrium
C	10	10	50	05	Unstable equilibrium
D	27	27	567	21	Inefficient equilibrium

we implement is a symmetric game where each subject's real payoff depends only on her own price and on the average price of other (n-1) players. The payoff table and the structure of the pricing game are the same as used by Fehr and Tyran (2004).

This study is based on two experiments. The experiments have 10 periods each and there are 6 and 4 groups, respectively in the first and second experiments with 4 peoples in each group.

Subjects are explained about the rules of the experiment. Subjects are shown the payoff table and described about the outcome of an action in the group. Finally, each subject is given a payoff table to keep in hand for the rest of the experiment and is allowed 7 min before the experiment to think about it. Subjects are in a group of 4. The group is anonymous and remains unknown throughout the experiment. They are told that this is a pricing game. Subject has to make her own price and to expect the average price of the others. Payoff is determined by the price she is choosing and the average price of the others in her group. The payoff calculation is summarized in the payoff table, they are supplied. Notice that this is a nominal payoff table. The calculation of their real payoff is simple: nominal payoff divided by the average price of the other three members of her group. For one's performance, only real payoff matters. At the end of each period subjects are informed about their chosen price, average price of other members of her group and the resulting real payoff. All are displayed in the computer screen very shortly.

Market prediction: This is a symmetric n player pricing game and each of the n players in the group has the same payoff table. In this game, each subject simultaneously chose a price Pi $\in$ (1, 2, 3,…., 30). Each subject's real payoff depends on the subject's own price and on the average price of the other n-1 players, $\bar{P}_{-i}$. Since, the game is symmetric one, the equilibria in this game are located in the 45° line of the payoff table. Any outcome not located in the 45° line is simply no equilibrium in this symmetric game. Table 1 shows the hypothetical equilibria in this game.

Subjects are given the payoff in nominal terms. To obtain the real payoff, we have to deflate the nominal payoff by the prevailing level of $\bar{P}_{-i}$. If subjects have adaptive expectations and play a best reply to their expectation, equilibrium A and D are stable. Equilibrium B is no equilibrium, since it is a symmetric game, while equilibrium C is unstable one: subjects are not maximizing either the nominal or the real payoff here. Table 1 shows that equilibrium D gives a nominal payoff that is much higher than that of equilibrium A, but it is Pareto inefficient. Equilibrium A is Pareto efficient as it provides higher real payoff than equilibrium D.

Table 1 clearly shows that this pricing game is developed in a way to create a conflict between the principles of nominal payoff dominance and that of real payoff. If the agents are rational, the real payoff dominance predicts that equilibrium A would be selected regardless of whether payoffs are represented in nominal or real terms as it assumes that subjects can pierce the veil of money, when the presentation is nominal. While, the principle of nominal dominance predicts that equilibrium A would be chosen by the agents only if the presentation is in real terms but equilibrium D is selected in case of nominal representation.

Thus in this experiment, if we assume that subjects are choosing equilibrium D under this nominal representation, we could obviously conclude that there exists nominal payoff dominance and the subjects are prone to money illusion. Furthermore, if we find that the coordination of the subjects are locked in the inefficient equilibrium D, we can interpret that money illusion has permanent real effects even though subjects are coordinating and have a good command over economics training.

The experiments have no treatment differentiation as Fehr and Tyran (2004). Instead, we are just focusing on whether the economic agents with solid economics training could pierce the veil of money, even with coordination in repeated periods of time.

RESULTS AND DISCUSSION

In this pricing game, there are multiple equilibria. In this study, we see that the Pareto efficient equilibrium is A with price 4 and the resulting real payoff is 28. In this study, we are presenting the experimental results and compare these with the theoretical prediction as we made in the preceding study.

Table 2: The group average prices over time in experiment 1

	Groups					
Periods	1	2	3	4	5	6
1	17	21	17	19	26	27
2	20	24	17	18	27	28
3	22	26	19	17	26	28
4	23	28	21	17	27	28
5	26	28	22	19	27	27
6	27	24	23	20	28	27
7	27	26	24	21	28	27
8	27	27	26	22	27	27
9	27	28	27	25	26	27
10	26	28	28	27	27	27

Table 3: The group average prices over time in experiment 2

	Groups			
Periods	1	2	3	4
1	14	23	26	23
2	14	23	27	23
3	12	24	27	23
4	12	22	27	24
5	12	23	27	25
6	11	25	27	27
7	11	25	27	27
8	12	26	27	27
9	12	26	27	27
10	14	27	27	27

The evolution of prices: The evolution of prices that is the group average prices are shown in Table 2 and 3 for the first and second experiments, respectively. Table 2 shows that there is a substantial deviation of prices from the Pareto efficient price. Neither of the groups is choosing the efficient price in a single period of time. Rather there is a trend of gradual convergence to the inefficient price of 27. Some groups are much faster in converging to this inefficient equilibrium than the others but the overall trend is a convergence to the inefficient equilibrium instead of to the efficient one. The same scenario is shown in Table 3 for the second experiment. Group 3 in this experiment reached to the inefficient equilibrium price in the very beginning followed by group 4 and the others later. Group 1, here is an example of discoordination where there is no coordination at all. And the common thing is that neither of these groups is choosing the efficient price in a single period of time similar to the groups in the first experiment. The data in Table 2 and 3 also show that there is a lock in possibility once a group reaches in an inefficient equilibrium.

Table 2 and 3 the straight thick dashed lines show the efficient equilibrium price, while the solid ones show the inefficient prices. The corresponding group average price lines exhibit a general and clear trend of convergence to the inefficient price, far from the efficient one. Furthermore, as time proceeds, we see a continuous divergence of prices from the efficient price.

These results clearly show that subjects are prone to money illusion and there exists nominal payoff dominance. Subjects are not looking for the real payoff rather just taking nominal payoff as the proxy for it. There is no learning over time and coordination occurs only in form of inefficient outcome.

We can also see the percentage of subjects choosing the efficient and inefficient equilibrium in different periods in Table 4 and 5 for the first and second experiments, respectively.

Table 4 and 5 show that throughout the experiments not a single subject choose the efficient equilibrium, while there is a gradual convergence to the inefficient equilibrium up to 70 and 55% of the subjects in the successive experiments. This result corresponds to the fact that subjects are taking nominal payoff as the proxy for their real payoff. As a result not a single subject is choosing the efficient price that might produce a lower level nominal payoff but efficient higher real payoff.

Instead, they are choosing and trying to attain the maximum of nominal payoff. This indicates a clear sign of money illusion at the individual level. Based on the, Table 4 and 5, we cannot simply overrule money illusion from economic discussion even though the subjects are of with enough economics background. Nominal representation of the objective situation might have ruled over their economics training. And if this is the case, we cannot ignore that money matters.

Payoffs: As we have already learned from previous discussion that subjects are not converging to the efficient equilibrium rather there is a gradual convergence to the inefficient outcome, which necessarily results payoffs much lower than the efficient one. Table 6 and 7, we shown that the groups in the experiments are earning a very low level of payoffs in the beginning with a gradual increase in the following periods. The highest payoff earned in a single period by the groups is 21, which is the outcome of the inefficient equilibrium D stated in Table 1. Neither of these groups is able to secure the efficient payoff 28, as there are no groups making the efficient equilibrium A.

These results are shown graphically in Table 6 and 7, respectively for the corresponding first and second experiment data sets. The gradual increase in payoffs seems to reflect that subjects are coordinating over time. Since, the game is a symmetric one the principal diagonal of the payoff table corresponds to the respective equilibria.

Futhermore, since the game has multiple equilibria and the subjects have adaptive expectations, each t + 1 period outcome reflects group efforts for stable equilibrium learning from the outcome in period t. In this study, we shown in Table 1 that there are two stable equilibriums: A and D, with resulting payoffs of 28 and 21, respectively. From the Table 2 and 3, we also learn that subjects are converging to the inefficient stable equilibrium D instead of A, we thus, find a lower level of payoffs in Table 6 and 7, the solid thick lines. The efficient payoff if subjects are choosing the efficient equilibrium. The deviation of group average payoff lines from it simply represents the payoffs forgone due to money illusion.

Efficiency: Efficiency in this study, simply corresponds to the maximization of real payoff. Any deviation from the efficient outcome is simply regarded as inefficiency: a potential loss for the particular subject, her groups as well as the market as a whole.

Table 8 and 9 summarize the efficiency magnitude attained by the groups in different periods in both of the experiments. Total payoff in Table 8 and 9 simply sums up payoff actually earned by each group over time in respective experiment this is simply the respective column sum from Table 6 and 7. The efficient total payoff is the potential amount of the payoff if the groups were really choosing the efficient equilibrium all the time. The discrepancy between the two measures the loss in payoffs resulting from the deviation of actual outcome to the efficient one.

In Table 8, we shown the striking result that groups are suffering efficiency losses in a considerable amount as high as up to 77% of potential real income. The best performing group in this experiment even suffer a loss in efficiency by 43%. The efficiency loss in the market as a whole is 61% that is three-fifth of the potential market income is forgone and wasted. Table 9 creates a further surprise: group 1 is losing 88% of its potential income! The market suffers a loss of 60% on an average, similar to the first experiment.

Table 4: Percentage of subjects choosing efficient and inefficient equilibrium in experiment 1

	Periods									
Equilibrium	1	2	3	4	5	6	7	8	9	10
Efficient	0	0	0	0	0	0	0	0	0	0
Inefficient	3.3	6.6	16.5	33	26.4	36.3	33	40.9	66	69.3

Table 5: Percentage of subjects choosing the efficient and inefficient equilibrium in experiment 2

	Periods									
Equilibrium	1	2	3	4	5	6	7	8	9	10
Efficient	0	0	0	0	0	0	0	0	0	0
Inefficient	5	10	20	15	25	25	35	35	45	55

Table 6: The group average real payoffs over time in experiment 1

	Groups					
Periods	1	2	3	4	5	6
1	1.4	2.2	1.2	3.4	6.6	4.2
2	3.4	4.0	2.6	2.8	5.6	10.2
3	10.6	6.4	4.4	4.2	15.4	13.4
4	12.4	17.4	7.4	3.8	14.2	15.4
5	4.2	7.4	6.4	2.6	19.0	17.0
6	17.8	2.0	7.4	5.2	15.0	19.0
7	17.0	3.4	7.2	9.8	16.4	17.8
8	17.0	10.6	11.0	8.4	17.0	21.0
9	15.8	17.4	19.0	10.6	17.4	21.0
10	15.2	17.4	15.8	13.0	21.0	21.0

Table 7: The group average real payoffs over time in experiment 2

	Groups			
Periods	1	2	3	4
1	3.4	1.8	14.6	2.0
2	2.0	4.6	17.0	7.6
3	2.8	10.6	19.0	8.6
4	2.6	2.0	17.0	11.2
5	2.0	8.8	21.0	12.2
6	4.2	11.2	21.0	19.0
7	3.6	9.2	21.0	19.0
8	5.0	9.0	21.0	19.0
9	3.4	12.0	21.0	21.0
10	6.0	13.4	21.0	21.0

Table 8: Total payoffs earned and the efficiency losses by the groups in experiment 1

	Groups						
Efficiency magnitude	1	2	3	4	5	6	Grand/ market total
Total payoff earned	114.8	88.2	82.4	63.8	147.6	160	657
Efficient total	280	280	280	280	280	280	1680
Loss in efficiency (%)	165.2 (59)	191.8 (68.5)	197.6 (70.6)	216.2 (77.2)	132.4 (47.3)	120 (42.9)	1023 (60.9)

Table 9: Total payoffs earned and the efficiency losses by the groups in experiment 2

	Groups				
Efficiency magnitude	1	2	3	4	Grand/ market total
Total payoff earned	35	82.6	193.6	140.6	451.8
Efficient total	280	280	280	280	1120
Loss in efficiency (%)	245 (87.5)	197.4 (70.5)	86.4 (30.9)	139.4 (49.81)	668.2 (59.7)

CONCLUSION

In this study, the potential source of efficiency loss is due to deviation from efficient equilibrium, resulting from subjects' inability to pierce the veil of money. If the subjects were able to perceive the neutrality of money, or if there exists real payoff dominance instead of nominal dominance, subjects would correctly choose the efficient outcome A. Any deviation from it thus is due to money illusion among the subjects and any loss in efficiency is thus, simply the costs of money illusion. A market loss of 60 or 61% thus, reflects undoubtedly higher costs of money illusion, leaving three-fifth of income on the table!

Thus, the experiments show that money illusion has permanent real effect over time. Since the subjects are all well-equipped with economics training and still suffer from money illusion-conceding a huge efficiency loss-we cannot conclude, based on the experimental result that real world people are necessarily free from money illusion and money is certainly and surely neutral. Rather, the experimental evidence suggests non-neutrality of money, at least in the short run, with strong real and permanent effect.

Furthermore, recalling Fehr and Tyran (2001) and Wong (2005), we can extend their results by saying that we do not find any strong support that people with strong economic background have better foresight to pierce the veil of money. Equivalently, we can say that we do not find any clear evidence from the experiments that the problem of money illusion at the individual level is mitigated by the process of learning. Rather, we say that the delusion of money is so fascinating that even economists can do wrong!

REFERENCES

Akerlof, G.A., 2002. Behavioral macroeconomics and macroeconomic behavior. Am. Econ. Rev., 92 (3): 411-33.

Bewley, T.E., 1999. Why wages don't fall during a recession. MA: Harvard University Press, Cambridge.

Blinder, A.S., E.D. Canetti, D.E. Lebow and J.B. Rudd, 1998. Asking about prices. Russell Sage Foundation, New York.

Campbell, C. and K. Kamlani, 1997. The reasons for wage rigidity: Evidence from a survey of firms. Quart. J. Econ., 112: 759-789.

Fehr, E. and J.R. Tyran, 2004. Money illusion and coordination failure. CESifo Working Paper, No.: 1141.

Fehr, E. and J.R. Tyran, 2001. Does money illusion matter? Am. Econ. Rev., 91 (5): 1239-1262.

Fischbacher, U., 1999. Z-tree: Zürich toolbox for readymade economic experiments. University of Zurich, Working Paper No. 21.

Irving, F., 1928. The money illusion. New York: Adelphi.

Howitt, P., 2002. Looking inside the labor market: A review study. J. Econ. Literature, 40 (1): 125-38.

Kahn, S., 1997. Evidence of nominal wage stickiness from microdata. Am. Econ. Rev., 87 (5): 993-1008.

Kahneman, D., J. Knetsch and R. Thaler, 1986. Fairness as a constraint on payoff seeking: Entitlement in the Market. Am. Econ. Rev., 76 (4): 728-741.

Leontief, W., 1936. The fundamental assumptions of Mr. Keynes. Monetary theory of unemployment. Quart. J. Econ., 5 (4): 192-197.

Patinkin, D., 1965. Money, Interest and Prices. 2nd Edn. Harper and Row, New York.

Shafir, E., P. Diamond and A. Tversky, 1997. Money illusion. Quart. J. Econ., 62 (2): 1.

Tobin, J., 1972. Inflation and unemployment. Am. Econ. Rev., 62 (1): 3.

Tversky, A. and D. Kahneman, 1981. The framing of decisions and the psychology of choice. Science, 211 (4481): 453-458.

Wong, W.K., 2005. Does money illusion still matter after some economics education? Working Paper.