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Abstract

This paper investigates the individual outcomes of irrational thinking, including paranormality and non-scientific thinking. These modes of thinking are identified by factor analysis from a 2008 survey. Income and happiness are used as measures of performance. Empirical results reveal that both paranormality and non-scientific thinking lower income. While non-scientific thinking lowers happiness, paranormality raises it. Extending the model, we find that higher ability results in higher income and happiness. Self-control only raises happiness. These results suggest that many elements of *homo economicus*, except paranormality and selfishness, raise economic performance and happiness.

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1. Introduction

This paper aims to discover whether logical thinking is necessary for better human performance (income and happiness), using Japanese data.

Rationality is the essential assumption of traditional economics, meaning that agents think logically, not emotionally, about how to act in order to achieve their goals given their constraints.[1] In addition to rationality, the following elements are commonly ascribed to "*Homo economicus*": unlimited cognitive resources, pure self-interest, and perfect self-control (Cartwright, 2014). However, this is not the only possible description of economic agents; *Homo economicus* is often simply adopted for modeling convenience. Therefore, it is interesting to ask: "Does *Homo economicus* exhibit performance that is superior to real-world human beings?" In this paper, we focus on the effect of irrationality on performance, although we also investigate the impact of the other characteristics of *Homo economicus*.[2]

The consequences of irrationality have been studied in the field of behavioral finance. DeLong et al. (1990) analyzed the efficiency of a financial market that consists of a mix of rational and irrational agents, and showed that this market can be inefficient

[1] For more discussion of rationality, see Wilkinson (2008).
[2] Konow and Earley (2008), based on a dictator game experiment, found that more generous people report greater happiness.

if irrational agents comprise a substantial fraction of market participants.[3] The result suggests that whether or not irrationality leads to lower profitability depends on the total number of irrational agents in the market. If irrational agents dominate, behaving irrationally in concordance with many other irrational agents can be profitable.

Shumway and Wu (2006) empirically analyzed the Shanghai stock exchange and found that traders who show the disposition effect earn less profit. Barber and Odean (2001) showed that men transact too often because of their overconfidence, leading to low profitability. These empirical results are consistent with the hypothesis that irrationality reduces profitability.

To be more rational, it is necessary to think logically, which is the unique tool by which human beings identify the appropriate actions to achieve their goals. We measure individuals' degree of logical thinking by assessing the degree to which they believe in science and the degree to which they believe in paranormal phenomena. Although these may seem to be two sides of the same coin, they actually have different characteristics, as will be demonstrated in section 2.[4] While paranormality has not often been analyzed in the economics literature, there have been many studies on this topic in the field of

[3] The authors assume that rational agents are risk averse, which restricts them from making unlimited arbitrage.

[4] Lindeman and Aarnio (2007) offer some support for this; they report that superstition is well predicted by ontological confusion, but not by analytical thinking.

psychology. However, the relationship between paranormal beliefs and individual success has, to our knowledge, not yet been studied. Since people who believe in paranormal phenomena do not understand the world correctly, they tend to miss chances for achieving success.

The majority of Japanese people do not believe in any religion: according to our large scale-survey, 56% answered "None" to the question "Please indicate if you are affiliated with any of the following religions." Also, 58.5% answered "It doesn't hold true at all" to the statement "I am deeply religious;" those who answered "It is particularly true" comprised only 3.4%. Nonetheless, belief in paranormal phenomena is popular, especially for the younger generation, as in many countries (Williams et al. 2007, Rice 2003, Peltzer 2003). Thus, religious beliefs, at least, may not be the only source for the spread of paranormal beliefs, especially among younger individuals; superstitions spread by mass media may be an important origin.[5]

We assess an individual's performance with two measures: 1) income, and 2) happiness. Success in the world is often evaluated by income, assets, and social status; attainment of these goals is largely determined by objective conditions including personal traits and environment, although chance also plays a large role. On the other

[5] Fortune-telling based on blood types or horoscopes is broadcasted daily on many Japanese TV channels.

hand, human beings also pursue subjective happiness, which is strongly affected by one's mental condition. Indeed, Wills (2009) reports that higher satisfaction with spirituality and religiosity brings about significantly higher well-being (see also Cohen 2002). Although happiness depends on income to some degree, the two may sometimes diverge. Thus, we investigate how paranormality and non-scientific thinking affect both income and happiness.

The remainder of this paper is organized as follows. In section 2, we explain the data and methods used. In section 3, we present the basic results and check robustness. In section 4, we extend the basic model to examine how characteristics of *Homo economicus* other than rational thinking affect performance. Section 5 concludes.

2. Data and methods

In this section, we explain our dataset and report the results of an analysis regarding the origins of belief in paranormality and non-scientific thinking.

2.1 The questionnaire survey

All data used in this paper were obtained from a survey conducted by the COE (Center of Excellence) project of Osaka University in February 2008. The questionnaire consists

of 92 questions, some of which include sub-questions. Although the survey had been conducted since 2003, questions to elicit paranormal beliefs and non-scientific thinking were only asked in 2008. Three thousand and forty eight (3,048) people aged 20-75 were selected from all over Japan by double stratified random sampling, so that we obtained a representative sample of the Japanese populace. Selected respondents were visited at their homes and handed the questionnaire. Several days later, completed questionnaires were picked up. Two thousand seven hundred and thirty one (2,731) questionnaires were returned (response rate of 89.6%). At the same time, 3000 individuals were randomly chosen from all over Japan, and the same questionnaire was sent by postal mail to these. One thousand two hundred and eighty seven (1,287) of these were returned (response rate of 42.9%). In this paper, these two samples are pooled and used for the analysis, so that the total number of observation is 4,018. The respondents were rewarded with a voucher valued of 1500 yen (about US$14).[6]

2.2 Questions associated with irrationality

We designed questions that elicit an individual's degree of belief in paranormality (henceforth "paranormality") and non-scientific thinking; we collectively refer to these

[6] $1=¥106.58 on February 1, 2008.

two measures as “irrationality.” Paranormality is assessed with eight questions and non-scientific thinking with three; these questions are listed in Table 1. Each response is on a five-point scale.

The standard questions used to measure paranormality, the Paranormal Belief Scale (PBS), were developed by Tobacyk and Milford (1983) and are widely used (Hergovich and Arendasy 2005, Aarnio and Lindeman 2005, Dagnall et al. 2007, Peltzer 2003). These authors propose a 25-item questionnaire based on the results from factor analysis of a 61-item pool. Factor analysis revealed seven independent dimensions comprising belief in the paranormal. Out of our eight questions on paranormality, four are related to factor 1 in Tobacyk and Milford, one belongs to factor 2, and one to factor 7. Thus, our questions are somewhat similar to those in Tobacyk and Milford. However, Wiseman and Watt (2004) criticize the PBS, pointing out “this scale refers solely to negative superstitions (e.g., breaking a mirror will cause bad luck) and omits items referring to positive superstitions (e.g., carrying a lucky charm will bring good luck).” Another measure, the Belief in Paranormal Scale (BIP), has been proposed, which assesses both paranormal beliefs and experiences (Thalbourne and Delin 1993, Rattert and Bursik 2001). Williams et al. (2006) and Rice (2003) each propose their own measures. In sum, although the PBS is the most common measure

used to assess paranormal beliefs, there exist a variety of alternatives.

From Table 1, we can see that belief in paranormality and non-scientific thinking are very common. Except for the question regarding whether "human beings evolved from other living things," the modal response is in the middle of the 5-point scale.[7] Though the number of responses indicating non-belief in science is a minority, the distribution of the answer is almost symmetric for the questions on the existence of gods, heaven, ghosts, and the afterlife. Many answered "true" for questions such as "God or gods exist" "Life after death exists," and "God knows about all the wrong things we've done."

2.3 Factor analysis

We asked eleven questions concerning irrationality. Needless to say, irrationality is not the sole determinant of the answers to these questions. Therefore we performed a factor analysis on the set of eleven questions.[8]

The results of that factor analysis are presented in Table 2. It is clear that the eight questions associated with paranormalilty have a large loading on the first factor, while

[7] Although in the original questionnaire, 1=totally agree and 5=totally disagree, we reversed the number for some questions so that larger numbers indicate greater paranormality and more non-scientific thinking.

[8] Specifically, we use principal factor analysis (PFA) with promax rotation.

the second factor strongly relates to the three questions associated with non-scientific thinking. We therefore name the first factor *PARANORMAL* and the second *NONSCIENTIFIC*.

2.4 Where do belief in paranormality and non-scientific thinking come from?

In this subsection we examine how paranormality and non-scientific thinking emerge. We particularly focus on the effect of the respondents' childhood environments.

We define the average years of schooling of a respondent's parents as *EDUCTION_P*.[9] We hypothesize that higher parental education directly and indirectly leads to children thinking more rationally. Another variable is standard of living at age 15 (*LIVING_15*), which ranges from 0 (poorest) to 10 (wealthiest). Although the direction of the effect on rationality is not intuitively obvious, we hypothesize that growing up with hardship will discipline children and keep them from subscribing to irrationality, other thing being equal. Another important variable is intelligence, which, we hypothesize, increases rationality. We proxy for intelligence with a respondent's self-reported grades (averaged across all academic subjects) at the age of 15

[9] When respondents have only one parent, the variable is defined as the schooling years of that parent.

(*ABILITY*).[10]

Gender may play an important role, because boys and girls are often educated to behave differently and to seek different life goals. We thus include a dummy variable *DMAN*, which takes on a value of unity for males and zero for females. Age may represent generation, which could reflect the degree to which the media reported on paranormal phenomena when that generation was young; alternatively, belief in paranormality might depend on age itself. Thus, we add age decade dummies (e.g. *D_AGE20* is a dummy representing whether a respondent is in his or her 20s) to the regression. The dummy for 70s is deleted as the benchmark.

Estimation results by ordinary least squares (OLS) are presented in Table 3. Factors influencing paranormality appear on the left. Females tend to have stronger belief in paranormality than males, which is consistent with previous studies (Rice 2003, Wolfradt 1997, Wiseman and Watt 2004, Williams et al. 2007).[11] Paranormality tends to be strongest when respondents are in their 40s. Those who had higher grades at age 15 tend to exhibit less paranormality, as do those whose parents are more educated. Interestingly, a higher childhood standard of living is associated with more

[10] Musch and Ehrenberg (2002) used grades in junior high school as a proxy for cognitive ability and examined the correlation with paranormality.

[11] However, Peltzer (2003) finds no significant gender differences among secondary and university students in South Africa.

paranormality.

Results regarding non-scientific thinking are shown in the right-hand columns. The results are similar to those for paranormality. The only differences are that parents' education and childhood standard of living are here only significant at the 10% level. Another difference is that non-scientific thinking decreases monotonically with age. This last result presents an interesting contrast with the result for paranormality. Respondents in their 40s were teenagers around 1978, when paranormal phenomena - spoon-bending by Uri Geller and Kokkuri-san (a kind of table-turning), etc. - were very popular in the media. Therefore, we might be seeing a generational effect.

2.5 Income and happiness as measures of life performance

We use two measures of an agent's life performance: income and happiness. The former is a purely economic measure of performance, while the latter is psychological and self-evaluative. 2007 pretax income (on a 12-point scale) is included as a question in the survey. Following Barsky et al. (1997) and Kimball et al. (2008), we fit a lognormal distribution to the income histogram and estimate the income for each class; the logarithm of this estimation result is called *INCOME*.

HAPPINESS is defined by the answer to the following question: Overall, how

happy would you say you are currently? Using a scale from 0 - 10 where “10” is “very happy” and “0” is “very unhappy”, how would you rate you current level of happiness?

2.6 Statistical analysis

We regress the performance variables, *INCOME* and *HAPPINESS*, on the variables representing irrationality, *PARANORMAL* and *NONSCIENTIFIC*, and or control variables. Following Hashimoto and Raisian (1985), Mincer and Higuchi (1988), and Clark and Ogawa (1992), we assume that the wage rate is determined by (potential) working experience (*WEXP*) and its squared (*WEXPSQ*), and employment tenure (*TENURE*) and its squared (*TENURE*2). We also add male dummy *DMAN*, because males tend to earn higher wages than females.

Annual income is determined by the wage rate as well as by the number of hours worked in a year. Thus, for the income equation, we add working hours per week (*WHOUR*) and working days in a year (*WDAY*), which are asked in our survey.[12] Thus, the income equation is:

[12] Because many respondents didn’t tell us their number of working days and working hours, the sample size for the income regression is about the half of the total number of observations.

$$INCOME_i = \mathrm{a}_0 + \mathrm{a}_1 PARANORMAL_i + \mathrm{a}_2 NONSCIENTIFIC_i + a_3 WEXP_i + a_4 WEXPSQ_i + a_5 TENURE_i + a_6 TENURESQ_i + a_8 DMAN_i + a_9 WHOUR_i + a_{10} WDAY_i + \varepsilon_i \quad (1)$$

Here *INCOME* is the logarithm of annual income. Working experience (*WEXP*) is defined as age minus the age of the last school graduation. Employment tenure (*TENURE*) is the working years at the current employer. *i* indexes individuals and ε_i is a disturbance term..

We calculate the wage rate (*WAGERATE*) as the logarithm of (annual income / working hour per week * 52), and we then estimate the wage equation:[13]

$$WAGERATE_i = \mathrm{a}_0 + \mathrm{a}_1 PARANORMAL_i + \mathrm{a}_2 NONSCIENTIFIC_i + a_3 WEXP_i + a_4 WEXPSQ_i + a_5 TENURE_i + a_6 TENURESQ_i + a_8 DMAN_i + \varepsilon_i \quad (1)',$$

where *WAGERATE* is in logs.

Since it is well known that happiness depends on gender and age (Frey and Stutzer 2002), we add these variables to the regression equation for *HAPPINESS*:

$$Happiness_i = \mathrm{b}_0 + \mathrm{b}_1 PARANORMAL_i + \mathrm{b}_2 NONSCIENTIFIC_i + \mathrm{b}_3 DMAN_i + \mathrm{b}_4 AGE_i + \mathrm{b}_5 AGE\_SQ_i + \varepsilon_i \quad (2)$$

[13] We deleted 5 samples whose wage rate exceeds ¥15000, since a wage of this level seems quite rare in Japan.

It is also known that subjective happiness depends on income in cross sectional analyses (Frey and Stutzer 2002). Thus, we estimate a variant of equation (2) that includes income:

$$Happiness_i = \mathrm{b}_0 + \mathrm{b}_1 PARANORMAL_i + \mathrm{b}_2 NONSCIENTIFIC_i + \mathrm{b}_3 DMAN_i + \mathrm{b}_4 AGE_i + \mathrm{b}_5 AGE\_SQ_i + \mathrm{b}_6 INCOME_i + \varepsilon_i \qquad (3)$$

We must be careful regarding the interpretation of the estimation results for equation (3): b_1 and b_2 represent the direct effects of irrationality, but even if b_1 and b_2 are found to be statistically insignificant, these variables may indirectly affect *HAPPINESS* through *INCOME*. Equations (2) and (3) are estimated by ordered probit, since *HAPPINESS* is an ordered variable.

3. Estimation results

3.1 Effect of irrationality on income

The estimation results for equation (1) and its variants are presented in Table 4. On the left are shown the results when *INCOME* (log of annual income) is taken as the dependent variable. The coefficients on both *PARANORMAL* and *NONSCIENTIFIC* are negative; the former is significant at the 1% level and the latter at the 5%, implying that paranormal and non-scientific thinking lower economic performance. The coefficient of

EXPERIENCE is significantly positive, and its square is significantly negative, implying that longer experience contributes to a higher wage, but at a diminishing rate. Similar results are obtained for job tenure. The coefficient on the male dummy is significantly positive, implying that males enjoy higher wages than females with the same *EXPERIENCE* and *TENURE*. While the coefficient on working hours is significantly positive at the 1% level, working days are negative but insignificant.[14]

The second columns present our estimates for *WAGERATE*. The coefficient on *PARANORMAL* is negative and significant at the 1% level, and the coefficient of *NONOSCIENTIFIC* is also negative and significant at the 10% level. The other variables are similar to those in the first columns. The maleness dummy, *DMAN*, is significantly positive, as expected.

In sum, we have a robust result that both belief in paranormality and non-scientific thinking lower income as well as wages.

3.2 Effect of irrationality on happiness

Estimation results for equation (2) (the *HAPPINESS* regression) are presented in panel A of Table 5. The left-hand columns show the results when only the two key

[14] This might be due to the fact that workers at medium and small firms tend to work on Saturdays and national holidays more often than workers at large firms, and to have a lower wage rate.

explanatory variables are included. Interestingly enough, the coefficient on *PARANORMAL* is positive here, indicating that those who believe in paranormal phenomena are happier, while the coefficient on *NONSCIENTIFIC* is significantly negative, implying that non-scientific thinking lowers happiness. This result highlights the substantial functional difference between belief in paranormality and non-scientific thinking.

In the right columns, results for the full specification of equation (2) are shown. Once again, the coefficients of the two key variables, *PARANORMAL* and *NONSCIENTIFIC*, are significantly positive and negative, respectively. Age and squared age are not significant at all. Another statistically significant finding is that females are happier than males.

In panel B of Table 5, we present the results of equation (3), where *INCOME* is added to equation (2). While the coefficient on *INCOME* is highly significant as expected, the coefficients on *PANRANORMAL* and *NONSCIENTIFIC* are almost unchanged from panel A. The coefficient on *DMAN* is larger and age and squared age are now significant, indicating that the happiness function is U-shaped in age, which is consistent with many previous studies (Clark 2007).[15] We should note that the

[15] The results using age dummies indicate that happiness is lowest during people's 50s.

coefficients of *PARANORMAL* and *NONSCIENTIFIC* in panel B represent only their direct effect on happiness; they have also an indirect effect through income.

3.3 Robustness check: Alternative measures for *PANRANORMAL* and *NONSCIENTIFIC*

In this subsection, we check the robustness of the results presented in the previous subsections. In particular, we check whether the results remain unchanged when alternative measures for paranormality and non-scientific thinking are used.

Previous studies have examined the relationship between religious and paranormal beliefs (Williams et al. 2006, Rice 2003, Smith and Simmonds 2006). Education is also believed to relate to paranormal beliefs (Aarnio and Lindeman 2005, Peltzer 2003). Thus, it may be reasonable to include attitudes towards religion (*RELIGION*) and education level (*EDUCATION*) in our set of raw outcome variables, from which paranormality and non-scientific thinking are extracted by factor analysis. Specifically, *RELIGION* is defined as a survey respondent's agreement with the statement "I am deeply religious," and *EDUCATION* is defined by years of schooling.

We conduct a factor analysis of 13 outcome variables, including *RELIGION* and *EDUCATION* (results not shown). The factor loading of *RELIGION* on factor 1 is 0.216,

implying that it contributes to factor 1 as expected, but only weakly. On the other hand, *EDUCATION* has a factor loading of -0.132 on factor 2, which is an only small contribution. The other variables show similar factor loadings on both factors 1 and 2. Based on these results, we construct new variables *PARANORMAL2* and *NONSCIENTIFIC2*.

We estimate equations (1) through (3) with *PARANORMAL2* and *NONSCIENTIFIC2* on the left-hand side. All of the results in Tables 4 and 5 are qualitatively confirmed (results not shown); *NONSCIENTIFIC2* is now more significant, and its coefficient is now larger than in the previous estimations. Thus, the conclusions in the previous subsections are robust to the inclusion of religion and education in the factor analysis that we use to define paranormality and nonscientific thinking.

4. Performance of the *Homo economicus*: An extension

Homo economicus is characterized by rationality, perfect intellectual ability, perfect selfishness, and perfect self-control. Although we have focused on the effects of rationality, it is interesting to ask how the other attributes of *Homo economicus* affect individual performance. In this section, we define proxies for the other aforementioned characteristics of *Homo economicus*, using other answers to our survey questions, and

we investigate the effects of each characteristic on our performance measures.

4.1 Definitions of variables

In this subsection, we define the additional variables used in the regression analysis.

Intellectual ability (*ABILITY*)

For intellectual ability, we use subjects' self-reported school grades at age 15. Respondents were asked to choose from a 5-point scale, from 1 ("in the lower rank") to 5 ("in the higher rank").

Selfishness (*SELFISH*)

To measure selfishness, we used the answer to the following survey question: Does the following statement hold true for you? "I don't sit in a priority seat on public transportation because I want to offer it to others." Again, the response is on a 5-point scale, from 1 ("This is particularly true for me") to 5 ("This is not true for me at all"). *SELFISH* is defined by this answer.

Self-control (*SELFCONTROL*)

For the self-control variable, we asked whether the following six statements held true for the respondents, on a 5-point scale from 1 (does not hold true at all) to 5 (particularly true).

a) Even if I make plans, I end up procrastinating.

b) I always keep my promises.

c) When I have something I want, I can't bear not to buy it.

d) I always plan carefully before making an action.

e) No matter how angry I get, I don't shout at others.

f) When I am faced with a problem, I usually act before I think.

SELFCONTROL is defined by the sum of these answers; where appropriate, the signs of answers are reversed so as to assign higher values to greater self-control.[16]

Our regression equations are just equations (1) through (3), adding *ABILITY*, *SEFLISH*, and *SELFCONTROL* as regressors. Larger coefficients on these variables means that subjects are more akin to *Homo economicus*.

4.2 Estimation results for the extended model

Estimation results for the extended model are presented in Table 6. In the left-hand columns, the results for the extended equation (1) are shown. The coefficients on paranormality and non-scientific thinking are negative, but only paranormality is significant at the 10% level. This may be due to the inclusion of *ABILITY*. As was

[16] We also define two other variables, *SC_PLAN*, which is defined as the sum of answers to the questions a) through d), and *SC_FEEL*, which is defined as the sum of e) and f). However, estimation results using these are not different from those using *SELFCONTROL*.

shown in Table 3, both *PARANORMAL* and *NONSCIENTIFIC* are related to a lack of ability. When *ABILITY* is deleted from the specification, *PARANORMAL* and *NONSCIENTIFIC* are negative and significant at the 1% and the 5%, respectively (results are not shown). Gender has almost the same impact on income as in the original equation (1). The coefficient on *ABILITY* is positive and significant, while the coefficients on *SELFISH* and *SELFCONTROL* are not significant.

In the middle of the table, results for the extended equation (2) are shown. Paranormality affect happiness positively, and non-scientific thinking negatively, as in Table 5. Thus, the impacts of these variables on happiness are robust. The results for gender and age also do not change much. As for the effects of the other newly-added explanatory variables, coefficients of *ABILITY* and *SELFCONTROL* are significantly positive. *SELFISH* is negative but insignificant. The negative sign of the point estimate is consistent with previous studies on altruism (Konow and Earley 2008, Phelps 2001). When income is added (extended equation (3)), the estimation results are almost unchanged (right-hand columns).

5. Conclusions

This paper investigated the individual-level outcomes of irrationality. Although

rationality usually brings about better outcomes, if irrationality predominates in society, this may not be the case (DeLong et al. 1990). Thus, it is interesting to examine the outcome of irrationality empirically. We used two main concepts of irrationality, paranormal beliefs and non-scientific thinking, which were abstracted from eleven questions by factor analysis. Although both of these beliefs represent irrationality in that they contradict facts, factor analysis revealed that they are distinct phenomena.

This paper adopts two measures of individual performance: income and happiness. While income measures economic performance, happiness may be a good measure of self-evaluated performance, including psychological aspects.

Empirical results reveal that both paranormality and non-scientific thinking lower income. Interestingly enough, non-scientific thinking and paranormality affect happiness in opposite directions: the former lowers happiness while the latter raises it. As belief in religion is known to raise happiness (Cohen 2002), belief in paranormality might act similarly to religiosity.

We extended our analysis to investigate the effects of various other characteristics of *Homo economicus*. Higher ability resulted both in higher income and happiness. Higher self-control contributes to higher happiness. Selfishness did not have a significant impact. These results suggest that though many elements of *homo*

economicus raise economic performance and happiness, paranormality and selfishness act differently. While paranormality lowers economic performance, it raises happiness; selfishness does not affect either of them significantly, though our point estimate for its effect is negative. As it is known that altruistic and/or religious people tend to be happy, these are not surprising results.

The present paper has many limitations. First, endogeneity of the regressors may be a problem. The regressors are basic traits of human beings, which are probably inherited or determined in childhood, so that they should essentially be exogenous to the income and happiness of adults. However, we cannot totally deny the possibility that these basic traits are influenced by standard of living in adulthood. Since it seems like a formidable task to find appropriate instrumental variables for the questions asked in our survey, addressing the possible endogeneity problem remains as future work.

Second, *Homo economicus* may have basic traits that the present paper has overlooked. For example, Homo economicus is a maximizer rather than a satisficer, and many studies report that the former tend to be unhappier than the latter (Schwartz et al. 2002, Oishi et el. 2014). Another example is that hyperbolic discounting produces time inconsistency and less efficient behavior (Laibson 1997), whereas *Homo economicus* may be characterized by exponential discounting. In addition, human beings in the real

world cannot be homogenous: for example, naïve and sophisticated persons have systematically different behavior (O'Donoghue and Rabin 1999). Thus, analysis of various types of human beings is called for. Given these arguments, the present paper takes only a small step toward the study of *Homo economicus* as a benchmark for human effectiveness.

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Table 1. Questions on irrationality and descriptive statistics of the answers

Category	Question	Name of variables	Share (%)					mean	Standard deviation
			1	2	3	4	5		
paranormality	Spirits and Ghosts exist.	*GHOST*	15.21	15.33	40.58	20.60	8.27	2.914	1.136
	Heaven exists.	*HEAVEN*	10.40	11.10	48.86	22.08	7.55	3.053	1.023
	God or Gods exist.	*GOD*	9.58	10.55	40.41	28.53	10.93	3.207	1.081
	Life after death exists.	*AFTERWORLD*	14.71	12.96	43.18	20.62	8.53	2.953	1.124
	God knows about all the wrong things we've done.	*WRONGDOING*	10.71	12.72	39.70	26.31	10.56	3.133	1.106
	It is possible to move an object by using psychokinesis.	*PSYCHOKINESIS*	27.90	25.57	38.03	7.04	1.45	2.286	0.995
	I believe in fortune telling.	*FORTUNETELLING*	16.39	19.74	44.48	17.52	1.87	2.687	1.003
	A person's blood type indicates their character.	*BLOODTYPE*	12.74	20.03	42.72	23.33	1.17	2.802	0.975
non-scientific thinking	Human beings evolved from other living things.	*EVOLUTION*	18.33	36.64	34.96	6.22	3.84	2.406	0.981
	You should place a greater value on thinking with your head than with your heart.	*HEADTHANHEART*	5.12	33.52	56.01	4.72	0.62	2.622	0.685
	What is written in science text books is true.	*SCIENCETEXT*	5.41	38.65	49.66	5.13	1.15	2.580	0.724

Note: Each question asks: “Do you agree with the following idea?” Larger numbers indicate greater paranormality and more non-scientific thinking.

Table 2. Rotated factor loadings and uniqueness

Variable	Factor1	Factor2	Uniqueness
AFTERWORLD	0.856	0.015	0.265
GOD	0.809	-0.054	0.349
HEAVEN	0.802	-0.038	0.360
GHOST	0.704	0.041	0.498
WRONGDOING	0.702	-0.090	0.509
FORTUNETELLING	0.644	0.058	0.577
PSYCHOKINESIS	0.530	0.149	0.685
BLOODTYPE	0.427	0.020	0.816
HEADTHANHEART	-0.001	0.502	0.748
EVOLUTION	-0.066	0.362	0.868
SCIENCETEXT	-0.087	0.338	0.883

Note: Principal factor analysis with promax rotation was applied.

Table 3. Causes of paranormality and non-scientific thinking

	PARANORMAL		*NONSCIENTIFIC*	
	Coef.	Std. Err	Coef.	Std. Err
Constant	0.214	[0.108]**	0.204	[0.074]***
DMAN	-0.436	[0.030]***	-0.112	[0.021]***
D_AGE20	0.401	[0.087]***	0.380	[0.060]***
D_AGE30	0.440	[0.073]***	0.255	[0.050]***
D_AGE40	0.521	[0.068]***	0.256	[0.047]***
D_AGE50	0.306	[0.067]***	0.208	[0.046]***
D_AGE60	0.075	[0.067]	0.143	[0.046]***
EDUCATION_P	-0.024	[0.009]***	-0.011	[0.006]*
LIVING_15	0.051	[0.009]***	0.004	[0.006]*
ABILITY	-0.087	[0.015]***	-0.080	[0.010]***
Adjusted R^2		0.116		0.044
Number of Observations		3588		3588

Note: *, ** and *** indicate that the coefficient is significant at the 10%, 5% and 1% level, respectively.

Table 4. Estimation results for equation (1)

	INCOME		WAGERATE	
	Coef.	Std. Err	Coef.	Std. Err
PARANORMAL	-0.046	[0.016]***	-0.047	[0.017]***
NONSCIENTIFIC	-0.054	[0.023]**	-0.045	[0.025]*
EXPERIENCE	0.029	[0.006]***	0.024	[0.007]***
EXPERIENCE2	-0.001	[0.000]***	-0.0004	[0.000]***
TENURE	0.034	[0.004]***	0.029	[0.005]***
TENURE2	-0.0004	[0.000]***	-0.0003	[0.000]***
D_MAN	0.617	[0.034]***	0.404	[0.034]***
WHOUR	0.008	[0.001]***		
WDAY	-0.0004	[0.000]		
Constant	4.508	[0.112]***	6.443	[0.100]***
Obs		1775		1801
R-squared		0.38		0.21

Note: Dependent Variable is income. Estimation method is ordinary least squares.
*, ** and *** indicate that the coefficient is significant at the 10%, 5% and 1% level, respectively.

Table 5. Estimation results for happiness equations

Panel A. Results for equation (2)

	Coef.	Std. Err	Coef.	Std. Err
PARANORMAL	0.073	[0.017]***	0.044	[0.018]**
NONSCIENTIFIC	-0.146	[0.026]***	-0.161	[0.026]***
D_MAN			-0.185	[0.034]***
AGE			-0.0004	[0.009]
AGE2			-0.00002	[0.000]
Obs		3895		3895
Pseudo R-Squared		0.003		0.005

Panel B. Results for equation (3)

	Coef.	Std. Err	Coef.	Std. Err
PARANORMAL	0.065	[0.020]***	0.043	[0.021]**
NONSCIENTIFIC	-0.136	[0.031]***	-0.144	[0.031]***
D_MAN			-0.341	[0.049]***
AGE			-0.029	[0.011]***
AGE2			0.0003	[0.000]**
INCOME	0.115	[0.022]***	0.231	[0.027]***
Obs		2794		2794
Pseudo R-Squared		0.005		0.01

Note: Dependent variable is *HAPPINESS*. Estimation method is ordered probit. *, ** and *** indicate that the coefficient is significant at the 10%, 5% and 1% level, respectively.

Table 6. Estimation results for the extended model

	ln_INCOME		HAPPINESS			
	Coef.	Std. Err	Coef.	Std. Err	Coef.	Std. Err
PARANORMAL	-0.027	[0.016]*	0.06	[0.019]***	0.056	[0.022]**
NONSCIENTIFIC	-0.02	[0.023]	-0.083	[0.027]***	-0.082	[0.032]**
SELFISHNESS	-0.004	[0.014]	-0.017	[0.016]	-0.031	[0.019]
ABILITY	0.131	[0.014]***	0.179	[0.016]***	0.124	[0.019]***
SELFCONTROL	0.002	[0.005]	0.043	[0.006]***	0.043	[0.007]***
D_MAN	0.628	[0.034]***	-0.177	[0.035]***	-0.294	[0.050]***
EXPERIENCE	0.03	[0.006]***				
EXPERIENCE2	-0.001	[0.000]***				
TENURE	0.032	[0.004]***				
TENURE2	-0.0004	[0.000]***				
WHOUR	0.008	[0.001]***				
WDAY	-0.0002	[0.000]				
Constant	3.962	[0.158]***				
AGE			-0.001	[0.010]	-0.022	[0.011]**
AGE2			-0.0001	[0.000]	0.0002	[0.000]*
INCOME					0.192	[0.028]***
Obs		1735		3752		2719
R-squared		0.41		0.02		0.02

Note: We show Adjusted R-squared for the income regression and pseudo R-squared for the happiness regression. *, ** and *** indicate that the coefficient is significant at the 10%, 5% and 1% level, respectively.