Economics Bulletin

Volume 33, Issue 4

Income groups and long term investment

Burak Can
Maastricht University

Orhan Erdem
Borsa Istanbul

Abstract

Laibson (1997) suggests the present bias problem as one of the driving forces of excessive borrowing. Shefrin and Thaler (1988) suggest that self-control underlies national borrowing/savings rate. We conduct a survey with 65 people between the ages of 21 and 56 to check for present bias as well as self-control problems among individuals in Turkey using a quasi-hyperbolic discounting model. Our findings show that different income groups have similar discount factors, i.e., impatience levels, but very different degrees of dynamic inconsistencies, i.e. present bias levels. In particular, 32.2% of low-income individuals exhibit present bias whereas this is down to 5.9% for high-income individuals. This result does not depend on a particular assumption of a utility function. Using the parameters we elicit through the surveys, policymakers can design appropriate commitment devices for time-inconsistent individuals to ensure a sustainable level of aggregate saving and financial investment.

Borsa Istanbul, Research Department, e-mail: orhan.erdem@borsaistanbul.com. The views and opinions in this article belong to the author(s) and do not necessarily reflect those of the Borsa Istanbul management and/or its departments. The authors are grateful to Kirsten Rohde and Ingrid Rohde for their comments on earlier versions of this paper.
Citation: Burak Can and Orhan Erdem, (2013) "Income groups and long term investment", *Economics Bulletin*, Vol. 33 No. 4 pp. 3014-3022.
Contact: Burak Can - b.can@maastrichtuniversity.nl, Orhan Erdem - Orhan.Erdem@borsaistanbul.com.
Submitted: September 12, 2013. **Published:** December 23, 2013.

1 Introduction

According to the World Bank[1], the worldwide average savings rate has been declining, and has reached a 35-year historical minimum, 19% in 2009. The decreasing savings ratio is of special importance especially in developed countries, and has been discussed in various studies. Hershfield (2011) attributes this decline to the increasing life expectancy. That is, people live longer, and hence experience a longer retirement period compared to the past, but their saving behavior cannot keep pace by saving more for longer retirement period. Discounting is the key aspect in savings behavior since savings can be perceived as choices of consumption over time. A considerable amount of research in finance, economics and psychology show that people's preferences, and hence discounting factor, change over time. This phenomenon, which is referred to as time inconsistency, and its consequences have been examined both through experiments and field studies. Various measures have been proposed to explain time inconsistency, including Loewenstein and Prelec (1992), Harvey (1986), Phelps and Pollak (1968) and Rohde (2010).

We analyze the behavioral aspects of failure to save and its relation to income levels, i.e., the reversal of time preferences as a dynamic inconsistency in different incomes groups. Kirby and Herrnstein (1995) show that individuals exhibit a reversal of preferences when choosing between *a smaller-sooner* and *a larger-later* reward. The "smaller" reward is preferred (present bias) if it offers an immediate payoff, whereas the "larger" reward is preferred if both options are delayed. Similar findings are of particular interest to the finance literature, since self-control underlies the national saving rate (Shefrin and Thaler, 1988). Hence, a deeper understanding of self-control problems would contribute to increased national savings. Besides, a number of studies suggest that time inconsistency also drives credit card borrowing (Laibson, 1997; Fehr, 2002). One of the commonly used formulations of such time preferences is based upon a quasi-hyperbolic structure (for example Phelps and Pollak (1968); Laibson (1997); O'Donoghue and Rabin (1999)).

Using a questionnaire with hypothetical[2] monetary outcomes, we aim to calculate the discount factor (level of impatience) and to measure the present bias in different income groups. Our aim is to highlight the correlation between income and individuals' discounting. A quasi-hyperbolic discounting model (see Phelps and Pollak (1968) and Laibson (1997)) is used to pursue this aim. This model allows for inconsistent individuals who think they will save in the future but fail to accomplish that when the future arrives. A random sample of 65 subjects between the ages of 21 and 56 from Turkey is used for the survey which is distributed to two income groups; low and high. The former group is randomly selected among workers from a factory in İstanbul, whereas the members of the latter are randomly selected among professionals in a private company located in İstanbul. The survey is conducted face-to-face. We show that even though the discount factors do not differ with respect to income groups, there is significant evidence that the number of individuals with present bias is different across income groups. The detection of the time inconsistency, i.e., present bias, does not require a particular assumption on the utility functions. The findings show that the proportion of people with dynamic inconsistency (present bias) is much higher in the low

[1]World Development Indicators, (WDI)

[2]The usage of hypothetical choices rather than real incentives can be seen as debatable and has been heavily discussed in the literature (see Attema et al. (2010)). However, majority of the papers conclude that the results do not change depending on the type of the incentive. For example, reviewing 74 experimental papers and analyzing the effects of zero, low and high financial performance-based incentives, Camerer and Hogarth (1999) state that even though incentives may improve performance, they often do not.

income group (32.2%) than in the high income group (5.9%).

Using the parameters we elicit through the surveys, we can recommend a commitment device to policy-makers to ensure a sustainable level of aggregate saving and financial investment for time-inconsistent individuals. This especially becomes important under the finding that low income individuals require a stronger "nudge" than those with high income.

The paper proceeds as follows: in Section 2, we discuss the quasi-hyperbolic model and its Samuelsonian predecessor. We discuss the survey, the dataset, and the variables in the end. Section 3 provides the numerical results regarding the impatience levels and the present bias in different income groups. Section 4 concludes the paper with a brief discussion of the findings.

2 The Model

It is natural that one chooses an earlier monetary reward to a later one of equal size. Depending on the level of impatience of an individual, there might be a certain reduction in the earlier reward which makes the individual indifferent between the earlier and later rewards. Subjective impatience of an individual over a time horizon can be estimated by his/her indifference between two such rewards. In the standard Samuelson (1937) utility discounting, the rewards on a timeline are discounted exponentially. A general time preference model hence looks as follows:

$$U = u_0 + \delta u_1 + \delta^2 u_2 + \delta^3 u_3 + \dots \tag{1}$$

Phelps and Pollak (1968) and Laibson (1997) suggested a revision of the standard model by incorporating a present bias element. In this model, decisions involving rewards now and in the future are driven by a different discount than decisions involving two future payments. This extension of the standard model to quasi-hyperbolic model is given below:

$$U = u_0 + \beta(\delta u_1 + \delta^2 u_2 + \delta^3 u_3 + \dots) \tag{2}$$

The novelty of this formulation of time preferences is that it provides room for explaining the behavior of so-called "time-inconsistent" individuals. Burks et al. (2012) provides a detailed comparison of the existing models and claims the quasi-hyperbolic formulation of time preferences to be better performing. Assume that the individuals are asked to choose between two payments; one in the 6th year, and one in the 7th year. Then the decision will involve comparison of the following: $\beta\delta^6 u_6$ and $\beta\delta^7 u_7$. When simplified, this is effectively a choice between u_6 and δu_7. In that case it is identical to standard discounting model being used since Samuelson. However a decision between now and next year is different: u_0 and $\beta\delta u_1$. In case an individual has present bias, the decision involving present time is favored. This favoring is done by discounting the later payment by an additional parameter β on top of δ.

2.1 The subjects and the survey

We use a questionnaire which was implemented also in Meier and Sprenger (2010). The detailed tables and the original questionnaire can be found in Can and Erdem (2013). The survey is conducted in Turkish, the subjects' native language, and is answered by 65 subjects. We categorized the subjects into two groups according to their income levels; low-income (LI) and high-income (HI). Individuals are considered as low-income if their monthly income is below 2000 TL. Individuals with

incomes above 2000 TL constitute the HI group.[3] More than 70% of the individuals in the LI group do not own a car or have rental costs. The LI subjects comprised of 31 individuals whereas the HI subjects amount to 34. The ages of the subjects vary between 21 and 56, with a (rounded) average of 31.36 and a median age of 29.

Table 1: Characteristics of the data set

	Age		Income interval	
	Mean	Median	Mean	Median
HI	27.4	27	3.5	3
LI	35.6	31	1.51	2
Total	31.3	29	2.55	3

Note: For the table, we use the midpoints of the intervals in the questionnaire.

The survey we use is a multiple choice list composed of three parts. The first part of the survey asks, in 6 questions, the subjects to choose between two options. The point where subjects switch from Option 1 to Option 2, in this part, gives us the interval of discounting between today and next month. The second part of the survey asks, in 7 questions, the subjects to choose between two options. The point where subjects switch from Option 1 to Option 2, in this part, gives us a range for the discount factor between today and 6 months later. The last part of the survey asks, in 6 questions, the subjects to choose between two options. The point where subjects switch from Option 1 to Option 2, in this part, gives us the interval of discounting between 6 months later and 7 months later.

2.2 Dataset and the variables

In the quasi-hyperbolic discounting model, we have one discount factor and one present bias parameter from the questions in Part 1 and 2 (δ_1 and β_1). We also have one discount factor and one present bias parameter from the questions in Part 1 and 3 (δ_2 and β_2). The average of the two discount factors gives us δ and the average of the two present bias parameters gives us β which we shall use as independent variables in the quasi-hyperbolic discounting model. The detailed derivation of these parameters can be found in Can and Erdem (2013) and Meier and Sprenger (2010).

- δ_1 and β_1: The discount factor and the present bias parameter induced by the indifference acquired from the first 6 questions in Part 1 and the 7 questions in Part 2 (the first 6 questions are discounted by $\beta_1\delta_1$ and the next 7 questions are discounted by $\beta_1\delta_1^6$).
- δ_2 and β_2: The discount factor and the present bias parameter induced by the indifference acquired from the first 6 questions in Part 1 and the last 6 questions in Part 3 (the first 6 questions are discounted by $\beta_2\delta_2$ and the last 6 questions are discounted by δ_2).
- δ: This is the average of the two discount factors (δ_1 and δ_2) described above.
- β: This is the average of the two present bias parameters (β_1 and β_2) described above.

[3]Note that the labeling does not necessarily reflect the wealth of individuals. Since the number of subjects who are interviewed are limited, we did not categorize them into more income groups.

One of the strongest points of our analysis is that our methodology enables us to detect present bias without the assumption of linear utility. We first look for individuals with a dynamic time-inconsistency, i.e., self-control problem or present bias. Such individuals exhibit different switching points in the first and the third part of the survey. In particular, an individual with present bias is supposed to switch from Option 1 to 2 at a later step in Part 1 than that in Part 3. Although in both parts the time-delay between options is one month, the questions in Part 1 involves an option "today", i.e., present time. This causes the individuals with self-control problems to delay their switch for the higher and later reward.

We define *the critical points* for each part, where individuals switch from Option 1 to Option 2. For instance, in Part 1, assume an individual prefers 65 TL today to 80 TL one month later. If this individuals prefers (in the next question) 80 TL one month later to 60 TL today, then we say the critical points are 60 TL and 65 TL. We take the average of those critical points and assume it to be the level of payment that would steer indifference between Options 1 and 2, e.g., indifference between 62.5 today and 80 one month later.

Given the critical points in each part, the levels of indifference between the Option 1 and Option 2 lead to following formulations. In Part 1, the two options u_0 and u_1 lead to: $u_0 = \beta\delta \times u_1$. In Part 2, the two options u_0 and u_6 lead to: $u_0 = \beta\delta^6 \times u_6$. In Part 3, the two options u_6 and u_7 lead to: $u_6 = \delta \times u_7$.

3 Results

We provide the results for both groups, low income (LI) and high income (HI), together with the total population (Total). The values are given in 3-digit decimals. We first provide discount factors when present bias is completely ignored, i.e., using the conventional standard exponential discounting. Thereafter we show our findings with the quasi-hyperbolic discounting model.

3.1 Impatience under standard exponential model (without present bias parameter)

As explained in the introduction, the standard model in Samuelson (1937) neglects the self-control problem which is known as present bias. Since there is only a single parameter in this exponential model, i.e., δ, each part in the questionnaire leads to a (possibly different) discount factor; δ_1, δ_2, and δ_3. We take the average of these discount factors to produce an approximation of the individual discount factors.

When the present bias parameter is not taken into account the standard exponential model of time preferences induces the following discount factors for the two groups:

- LI: 31 individuals exhibit on average a discount factor, $\delta = 0.810$,
- HI: 34 individuals exhibit on average a discount factor, $\delta = 0.833$,
- Total: 65 individuals exhibit on average a discount factor, $\delta = 0.821$.

Note that these findings imply that on average high-income individuals exhibit more impatience than the low-income individuals. However, this difference is not statistically significant. Next we apply the quasi-hyperbolic model and check for present bias. It turns out almost one third of

low-income individuals exhibit present bias whereas for high-income individuals this is the case for a small minority (2 out of 31).

3.2 Impatience and present bias under quasi-hyperbolic model (with present bias parameter)

We check for self-control problems in the data and find in total 12 (10 in LI group and 2 in HI group) individuals with present bias. 32.2% of low income individuals and 5.9% of high income individuals exhibit present bias, the difference is statistically significant with z-statistic of 2.73. The rest of the population is dynamically consistent and hence with no present bias, i.e., $\beta = 1$. Below is a summary of the data under quasi-hyperbolic model with standard errors in parentheses.

Table 2: Mean values for present bias and impatience

	n	(δ) Impatience	(β) Present Bias
LI	31	0.893 (0.0032)	0.954 (0.0051)
HI	34	0.893 (0.0025)	0.989 (0.0028)
t-stat	-	0.005	2.23
p-value	-	0.99	0.03

As it can be seen from Table 2, the equality of impatience parameter, δ can not be rejected with p-value of 0.99. However, the equality of present bias parameters β is rejected at 5 percent significance level. That is, the high income group can be considered as having a higher present bias parameter. Future research should analyze whether these different behavioral patterns are preference characteristics or driven by other factors such as liquidity. When we categorize the individuals with respect to whether they exhibit present bias or not, we have the following values. The individuals with present bias, 18.4% of the total population constitute an average discount factor of $\delta = 0.911$ and an average present bias of $\beta = 0.854$. The rest of the population constitute an average discount factor of $\delta = 0.888$ and naturally a present bias of $\beta = 1$.

3.3 Minimal return rate to induce savings

Consider an individual who discounts with δ for a one-month delay in a payment. In that case we say the minimal total return to trigger the savings decision for this individual is: $1/\delta$. This corresponds to a net return rate of the following expression:

$$r = \frac{1}{\delta} - 1 \qquad \text{(investing in the future)} \tag{3}$$

Note that some individuals may exhibit present bias. Due to this, the return rates which trigger these individuals to invest (or save) could be higher now than in the future. In the future the return rate they require to invest is equivalent to Equation 3 above. However, for decisions involving the present, the expression also is expanded by the present bias parameter:

$$r = \frac{1}{\beta\delta} - 1 \qquad \text{(investing now)} \tag{4}$$

We denote the return rate required today by $r_{present}$ and the rate for the future by r_{future}. On average, low income individuals require $r_{present} = 0.183$ and $r_{future} = 0.125$, whereas the gap for

high income individuals is much smaller, i.e., $r_{present} = 0.140$ and $r_{future} = 0.124$. For detailed datasets, we refer the reader to Can and Erdem (2013).

3.4 The Correlation of Personal Characteristics and Present Bias/Impatience

Here we seek the correlation between personal attributes and impatience (δ)/present bias (β). Note that impatience decreases as δ increases. Similarly present bias (time-inconsistency or self-control) decreases as β increases. The complete list of individual parameters for δ and β can be found in Can and Erdem (2013). We try to measure the effects of age and income within the total pool of subjects. The following two regression equations are estimated. The estimated parameters of these equations are also summarized in Table 3 below.

$$\text{PresentBias} = \alpha_1 + \alpha_2 \times \text{age} + \alpha_3 \times \text{income} \tag{5}$$

$$\text{Impatience} = \alpha_1 + \alpha_2 \times \text{age} + \alpha_3 \times \text{income} \tag{6}$$

Table 3: Regression results according to Equation 5 and 6

	(δ) Impatience	(β) Present Bias
Intercept	0.845(***)	1.010(***)
Age	0.001(*)	-0.002(**)
Income	0.003	0.011(*)
R-square	0.04	0.15

Note: The marks (***), (**),(*) show the 1%, 5%, 10% significance levels respectively.

As it can be seen from the second column of Table 3, only *Age* is significant (at 10% level) in the impatience regression. Therefore we can conclude that different income groups have similar impatience. However, both *Age* and *Income* are significant at 5% and 10% respectively in the present bias regression (third column of Table 3). As the results suggest, the present bias parameter increases with income. This means present bias (hence time-inconsistency) decreases as income increases. It is likely, then, that people with lower income are more easily tempted to spend in the present time. Note also that among the individuals with present bias, 83% belong to the low-income group. This suggests that it is mainly the low-income individuals that require savings schemes and commitment devices to eliminate the effects of present bias in their decision-making. The results in the third column reveals that the present bias parameter decreases with age. That is, older people have smaller present bias parameter, i.e. they tend to choose immediate monetary rewards as opposed to later rewards more than younger people do. That the age or income affects the discounting is consistent with various studies too. Read and Read (2004) show that older people discount more than young ones. Joshi and Fast (2013) claim that power makes people more connected to their futures. In this sense, income and being young can be perceived as a sign of power. That is, younger people and richer people may have more future-looking behavior than old and poorer people respectively. Moreover as Peterson (2007) (p.219) suggests, the ability to exercise self control may have been the driving reason to accumulate capital hence being rich. That is, the self control behavior may have caused the person to be rich.

4 Conclusion

The declining savings rates have been of special importance especially in the last years. Here we attempt to point out a behavioral aspect of failure in savings: the present bias of individuals. Although failure to save is not only a problem of the last decade, the concept "present bias" is relatively new in finance literature. Several studies show that time inconsistency is very much correlated with borrowing (Laibson, 1997; Fehr, 2002).

This study shows that the failure in savings can also be explained by behavioral aspects of decision making. Our study clearly shows that in particular the low-income and old-age individuals suffer present bias problem more than high income and younger people, respectively. Those who suffer present bias problem, therefore, fail to make decisions today that might be more beneficial to them in the future, e.g., savings. This is nevertheless good news since with proper commitment devices, such as offering present biased individuals some saving schemes for the future, overall savings can be increased. The commitment devices can be calibrated via the parameters such as the *minimal return rate to induce savings*, r. Financial/economic institutions may make use of our results by offering different saving instruments, to different income groups to change their consumption levels. This paper contributes to the literature by showing that designing commitment devices may help the authorities to increase overall savings of the society. Without changing the benchmark interest rates, an intelligent design may help the authorities to affect the savings rate.

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