Financial literacy and time preference: A classroom experiment

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Abstract

Time preference, the ability to delay gratification, matters for a wide range of life outcomes. Patience is relevant in the psychological, economic, and political spheres, as it is shown to affect financial and political behavior. But little is known about factors that explain variation in the degree to which individuals' discount future payoffs. This paper investigates whether financial literacy changes people's time preferences. Existing empirical research is plagued by a classic endogeneity problem — do more patient people have a propensity to acquire financial literacy, or does financial literacy actually lower their discount rate? In this paper I address this fundamental question about time preferences by conducting a classroom experiment on a sample of 216 undergraduate students. The results indicate that financial literacy, through learning concepts such as the time value of money, inflation, and capital budgeting, lowers discount rates, and that there is not a selection effect into finance and economics. Furthermore, results show that more education in general does not change time preferences, only financial literacy does.

Keywords: Financial literacy, classroom experiment, discount rates, time value of money, time preference

1 Introduction

Time preference refers to the phenomenon of an individual discounting the value of a reward to be received in the future relative to receiving the reward right now. The degree to which an individual discounts the future reward is referred to as the subjective discount rate or SDR: a higher SDR indicates that the individual is more focused on the present and less patient, a lower one indicates that the individual is more patient and future oriented. Patience is conceptualized as an individual-level disposition: some individuals are more patient than others, and these individuals are more likely to exhibit delayed gratification behaviors in several spheres. Patience plays a prominent role in both the economics and the psychology literatures. Findings suggest that more patient people are more cooperative and that they have better financial outcomes, for instance through searching longer for a good job, having higher credit scores, and being less likely to default on their loans (Curry, M. E. Price, and J. G. Price, 2008; Daly, Delaney, and Harmon, 2009; Della Vigna and Paserman, 2005; Ifcher and Zarghamee, 2011; Meier and Sprenger, 2007). Recently, scholars have also analyzed how patience is relevant in the political realm, specifically with respect to policy issues with long-term implications (Amdur et al., 2015; Fowler and Kam, 2006; Healy and Malhotra, 2009; Jacobs and Matthews, 2012; Magistro, 2019). To what extent are citizens willing to make sacrifices today in order to enact policies that will bear benefits in the long run? Existing studies provide some insights into this. Fowler and Kam (2006) find that patience significantly increases voter turnout. This is intuitive as the costs of voting must be borne before the benefits are realized, so people who are more patient should be more willing to vote. Similarly, Amdur et al. (2015) find that individuals with higher discount rates are significantly less likely to support the imposition of a carbon tax in comparison with individuals that have lower discount rates. Even when controlling

for other individual level attributes such as party affiliation a person's rate for discounting the future is shown to be a strong predictor of their support for a carbon tax. Jacobs and Matthews (2012) find clear evidence that the mass public discounts longer-term policy benefits. However, their data lends little support that this is due to varying time preference. In contrast, they find strong evidence across a diverse set of tests that uncertainty looms large in citizens' intertemporal policy assessments. Conversely, Magistro (2019) finds that financially and economically literate short-term losers from policies with long-term benefits are more likely to favor them than similar financially and economically illiterate individuals. She argues that financially and economically literate individuals may be more patient and finds support for this claim, as these individuals indeed have significantly lower subjective discount rates.

These studies clearly show that discount rates affect economic and political behavior, however the literature has been relatively silent on factors that explain variation in the degree to which individuals' discount future payoffs. A series of findings suggest that age and impatience are positively related, so as people become older they become more impatient. More education and higher income are associated with higher levels of patience. Finally, women consistently appear to be more patient than men, although it is not clear what the theoretical reasoning behind this empirical fact is. This study investigates the role that one aspect of education, specifically financial education, has on affecting subjective discount rates. Does financial literacy make people more patient? To answer this question, I use a classroom experiment among undergraduate students in economics and finance, and political science. In doing this I also attempt to address some endogeneity concerns that have undermined some past studies. The first question I tackle is whether learning financial concepts such as the time value of money contributes to changing time preferences and making people more patient. Secondly, I test whether there is a selection effects of students choosing to

study economics and finance, and hence whether they have lower SDRs to start with. Finally, I examine whether more education in general, not necessarily financial, decreases SDRs or not. Findings show that 1) financial literacy decreases subjective discount rates significantly; 2) there is not a selection effect into economics and finance, as students enrolling in these fields do not have substantively lower SDRs than other students when they start college; and finally 3) more schooling in general does not change time preferences, only financial education does.

The article proceeds as follows: in the first section I theorize how financial literacy may affect subjective discount rates and advance my hypotheses. Next, I discuss the survey design, present summary statistics and the models I use, and discuss the findings and their implications.

2 Theorizing the effect of financial literacy on discount rates

Although findings increasingly suggest that discount rates affect economic and political behavior, there is surprisingly little empirical evidence regarding the process through which discount rates are formed. A range of studies find a positive relationship between age and impatience, possibly explained by older people's expectations of a shorter stream of future utility (Becker and Mulligan, 1997; Booij and Praag, 2009; D. Read and N. L. Read, 2004). Furthermore, patience increases with financial resources (Becker and Mulligan, 1997; D. Read and N. L. Read, 2004). In Becker and Mulligan (1997)'s model of endogenous time preference, education can be seen as an investment in patience, hence explaining the positive association between the two. For instance, Perez-Arce (2011) uses a natural experiment in a public college in Mexico to test whether education affects time preference and he finds that schooling does indeed reduce SDRs, although without accounting for potential heterogeneity effects across majors. Similarly, Bauer and Chytilová (2010) find that

education has a significant impact on discount rates in Uganda.

A question that has not received much attention, and that is tested here, is that financial literacy may affect subjective discount rates. Financial literacy is defined by the OECD as 'a combination of awareness, knowledge, skill, attitude and behavior necessary to make sound financial decisions and ultimately achieve individual financial well-being'(Atkinson and Messy, 2012). The relationship between financial literacy and personal financial decisions is well documented in the literature (Behrman et al., 2012; Lusardi, 2015; Lusardi and Mitchell, 2007; Lusardi and Mitchell, 2011; Lusardi and Mitchell, 2017; Monticone, 2010). Financially literate people are more likely to make savvier saving and investment decisions, manage debt better, plan more for retirement, and participate more in the stock market (Lusardi, 2015; Lusardi and Mitchell, 2007; Lusardi and Mitchell, 2011; Lusardi and Mitchell, 2017). Financial literacy does not only affect household financial decisions, but it also impacts how people make decisions about public policies, including pension reforms, trade and immigration policies, and EU membership. Studies also show that financially literate people have lower SDRs (Lahav, Rosenboim, and Shavit, 2015; Magistro, 2019), and when it comes to public policy preferences, this may explain why in the presence of inter-temporal policy trade-offs, financially literate people are more likely to favor policies with long-term net benefits and short-term net costs (Magistro, 2019).

Given that findings suggest that financial literacy affects economic and political behavior and so do discount rates, it is of utmost importance to determine the direction of the relationship between financial literacy and discount rates to understand the significance of current findings and to inform future policy prescriptions. The direction of this relationship has been a cause of debate. On one side, Meier and Sprenger (2013) show that people who decide to acquire personal financial information through a credit counseling program are more future oriented (have lower discount

rates) than individuals who choose not to participate. On the other side, Lahav, Rosenboim, and Shavit (2015) find that financial education, through learning basic fundamentals of cash flow capitalization, significantly decreases discount rates. This paper aims to address two endogeneity problems that plagued some of the past studies. One is whether students that select into learning economics and finance have fundamentally different SDRs to start with, in line with what Meier and Sprenger (2013) find on a group of people deciding to acquire personal financial information. The other is whether more education in general decreases SDRs, or whether it is something specific to financial and economic education.

How does financial literacy affect SDRs? Financial literacy, through learning concepts like the time value of money, inflation, capital budgeting, risk and return in financial markets, and risk diversification, is expected to decrease SDRs. When learning about the time value of money, people learn that money available at the present time is worth more than the identical sum in the future due to its earning capacity. One would also learn the basic process to calculate the future value (FV) and the present value (PV) of an amount of money. For example if one were to calculate the future value, one year from now, of 100$ received today one would do:

$$FV = PV \times (1 + i)^n \tag{1}$$

where i is the interest rate and n is the number of compounding periods per year. If one can expect to earn 5% interest i on that sum in one year then the FV would be 105$. Assuming one does not need that money immediately, it is plausible that people who have learned about the time value of money, when asked about what sum of money would make them indifferent between 100$ now and that sum one year from now, are more likely to indicate a sum close to the FV of 100$, i.e., 105$.

3 Classroom Experiment Design

The classroom experiment attempts to isolate the effect of obtaining financial literacy from the selection process. I want to test whether acquiring financial literacy lowers SDRs, making sure there is not a selection effect into finance and economics, and that it is not just more education in general that lowers discount rates. To do this I identify the treatment group as students who have acquired financial literacy, while the control groups include first-year students (freshmen) selecting into economics before taking any classes, freshmen selecting into a different field (here political science) before taking any classes, and political science students after taking a political science class.

The total number of participants is 216 and they are all undergraduate students at the University of Washington. The survey consists of two pre- and post- parts: the pre- part involved interviewing the groups of freshmen *before* they take any economics or political science class in the first week of the quarter, while the post- part involved interviewing students *after* they take the finance or political science class in the last two weeks of the quarter[1]. The first *before* group includes freshmen students who were enrolled in Introduction to Microeconomics (Fin/Econ *before*) in fall 2019. Introduction to Microeconomics is the pre-requisite to any subsequent economics or finance class. The second *before* group includes freshmen students who were enrolled in Introduction to Political Theory, Introduction to Comparative Politics, Introduction to American Politics, or Introduction to International Relations (Poli Sci *before*) in fall 2019, who confirmed that they were not also enrolled in any course from the economics department or the business school. The freshmen

[1]More specifically, I am not interviewing the same students. The *after* groups were interviewed in winter and spring of 2019, while the *before* groups were interviewed in fall 2019.The rationale for this is that I wanted to make sure that the same students would not be in both the before and after groups, potentially affecting their answers.

in the these two groups were also asked if they had ever taken any economics classes before in high school, to further control for any selection effects and to make sure they were not already familiar with concepts like the time value of money, present value, or future value. Although in classes like Introduction to Microeconomics and Introduction to Macroeconomics concepts like the time value of money may be mentioned in passing, these are only explicitly taught in classes like Business Finance (FIN350) or Financial Economics (ECON422)[2]. This is where students learn concepts like the time value of money, inflation, capital budgeting, risk and return in financial markets, stocks, bonds and diversifiable risk. Hence, the first *after* group includes students who were enrolled in Business Finance in winter 2019 (Fin/ Econ *after*). The second *after* group includes students who were enrolled in Introduction to Political Theory in winter 2019 (Poli Sci *after*), who confirmed that they were not at the time and had never been enrolled in any course from the economics department or the business school.

The survey was emailed to the students, it was completely anonymous, and students were incentivized to participate by a separate raffle of 20 $20 Amazon gift cards they could enter upon completing the survey.

3.1 Questionnaire

The participants were asked a series of questions including questions on time preferences, risk preferences, income, age, gender, and freshmen were further asked whether they had taken economics classes in high school. Students younger than 18 and students in political science who had taken or

[2]I did my survey in Business Economics since it is offered every quarter and has over 200 students enrolled each quarter. ECON422 is not offered every quarter and classes are much smaller, around 35 students. Introduction to Microeconomics is a prerequisite for both FIN350 and ECON422.

were taking at the time classes in economics or finance were excluded.

Similarly to Lahav, Rosenboim, and Shavit (2015), I included a question in the survey that allows me to infer an individual's subjective discount rate. The question asks: 'You are supposed to receive 10,000 $ in your bank account immediately. Instead, we offer you the option of receiving a sum of money one year from now. Fill in the amount that you are willing to receive one year from now, instead of 10,000 $ today. Insert minimum amount' [3]. The annual discount rate for delaying payment was calculated as follows:

$$SDR = \left(\frac{P}{X} - 1\right) \cdot \frac{12}{t} \tag{2}$$

where P is the amount the subject is willing to accept in t months for delaying the receiving of the amount X today[4].

[3]I excluded individuals that reported numbers below 10,000 $, implying negative discount rates, as they likely resulted from misentering numbers or misunderstanding the question.

[4]Two methods are mainly used to measure SDRs: the choice-based methods and the matching method. Choice-based methods present participants with a series of binary comparisons and use these to infer an indifference point, which is then converted into a discount rate. Conversely, with the matching method, which is used here, subjects reveal an indifference point, and hence an exact discount rate can be imputed for a single response. Most often these indifference points can then converted to discount rates, using two popular equations: exponential or hyperbolic. The hyperbolic model has been found to descriptively model discounting data better than the exponential model and hence it is used here (Hardisty et al., 2013). As to the choice between choice-based methods or the matching method, there is no theoretical basis for preferring one of these methods over any other, but there are trade-offs for each and they actually yield very different discount rates. The former is often associated with an anchoring problem, where the discount rates may simply be recovering the expectation of the experimenter(Frederick et al., 2008). The latter though, although much quicker to ask, appears harder for participants to understand (Hardisty et al., 2013).

Table 1: Summary statistics for subjective discount rates across groups, excluding negative discount rates (n=185).

	Poli Sci *before*	Fin/Econ *before*	Poli Sci *after*	Fin/Econ *after*
Count	47	44	38	56
Min	0.04	0.0001	0.01	0.01
Q25	0.65	0.10	0.13	0.04
Median	1.0	0.5	1.0	0.1
Mean	3.9	2274.3	148.13	0.57
Q75	3.5	1.25	3.89	0.15
Max	29	99999	4999	10
Standard Deviation	6.73	15075.17	810.55	1.92

Table 2: Summary statistics for control variables across groups: relative frequencies and mean and standard deviation for age (n=216).

	Poli Sci *before*	Fin/Econ *before*	Poli Sci *after*	Fin/Econ *after*
Gender				
Female	62%	44%	69%	50%
Male	38%	56%	31%	50%
Income				
$0 - $24,999	7%	2%	15%	14%
$25,000 - $49,999	12%	9%	13%	10%
$50,000 - $74,999	12%	7%	6%	10%
$75,000 - $99,999	14%	9%	11%	16%
$100,000 - $124,999	16%	19%	15%	17 %
$125,000 - $149,999	9%	19%	4%	9%
$150,000 - $174,999	2%	13%	15%	5%
$175,000 - $199,999	5%	4%	11%	3%
$200,000 and up	21%	19%	11%	16%
Taken Econ Before				
Yes	45%	41%	N/A	N/A
No	55%	59%	N/A	N/A
Age	18.1 (0.23)	18.2 (0.42)	19.3 (1.2)	21.1 (3.9)

Tables 1 and 2 provide summary statistics on the participants. In line with previous studies (Lahav, Rosenboim, and Shavit, 2015; Magistro, 2019), SDRs have a very high mean and very high standard deviation, with some significant outliers, especially for groups not exposed to financial concepts [5]. Just by looking at these descriptive statistics it appears that the students acquiring financial literacy have significantly lower SDRs, hence in the next section I turn to the regression models.

4 Methods

The first hypothesis that I test is whether learning such concepts as the time value of money decreases subjective discount rates. To rule out a possible self-selection problem, I then test whether SDRs for freshmen enrolling in economics are significantly different from those of students enrolling in political science. To do this, I compare SDRs for freshmen choosing to take Introduction to Microeconomics (again, the prerequisite to any other economics or finance class) and freshmen not choosing any economics class, but a political science class instead. I further ask the freshmen in both groups whether they have taken any economics in high school. If the SDRs of freshmen choosing economics are already lower than those of students in political science, then there is a self-selection issue. Finally, to rule out the possibility that it is just more college education

[5]The *before* group in Lahav, Rosenboim, and Shavit (2015) has lower mean and much lower standard deviation than the *before* group of economics freshmen here. This may be due to the fact the in their study, students in the *before* group are business students right before taking Intro to Finance in their third semester, not before starting any classes in their first year. It is possible that in the past two semesters they have been at least exposed to the concepts then explicitly discussed in the Intro to Finance class, hence affecting their SDRs compared to freshmen not exposed to any economics or finance class yet.

in general that decreases SDRs across the board, I also test whether students have significantly different SDRs after they have taken a political science class compared to freshmen who have just started the political science class. To do this, I compare SDRs for students who have finished a course in Introduction to Political Theory (making sure these students have not been enrolled in economics or finance), and for freshmen who have just started Introduction to Political Theory.

To test these hypotheses, the plan is to use linear regression, controlling for potential confounders. However, as Table 1 shows, there are some very significant outliers in the data. Outliers can have a large distorting influence if we fit the regression using least squares. In order to address this issue, I take three steps. First, I run a robust regression[6], which reduces, but does not eliminate, the influence of outliers at a moderate efficiency cost. Secondly, I run a robust and resistant regression[7], which eliminates the influence of outliers, at a heavy efficiency cost, as much data will be discarded. Finally, I also run an OLS regression on a dataset that excludes the most extreme outliers[8].

5 Results

Tables 3 to 6 show the regression tables for all of the models, while figure 1 shows the first differences in mean discount rates among different groups for the average student in each group. Findings from Tables 3 to 6 show that learning basic capitalization concepts dramatically decreases discount rates, regardless of the models I use. However, no significant differences in SDRs exist between freshmen

[6]I fit a linear model by robust regression using an M estimator in R.

[7]I use the MM method in R, which uses the Biweight influence function initialized by a resistant S-estimator.

[8]Outliers are removed until there are no studentized residuals or standardized hat-values above 3.

who choose economics and those who choose political science, and no significant differences in SDRs exist between students *before* and *after* they take a political science class, suggesting that it is not just more schooling in general that decreases subjective discount rates. Conversely, students in the Fin/Econ *after* group have discount rates significantly lower than those in the Fin/Econ *before* group and than those in the Poli Sci *after* group.

To understand the substantive significance of these findings we can look at the first differences in SDRs between the Fin/Econ *before* and Fin/Econ *after* groups for the average individual. The expected subjective discount rate for the average student in the Fin/Econ *before* group is 57%, while for the average student in the Fin/Econ *after* group it is 11%. The difference of 46% between these two discount rates is statistically significant at the 95% confidence level. What this suggests is that students in the Intro to Micro class, before learning concepts like the time value of money, are more impatient and on average they demand a much higher SDR than students who have taken finance. Hence, acquiring financial literacy decreases discount rates and makes people more patient. Furthermore, the size of the effect for the Fin/Econ *before* and *after* groups are very similar to those found in Lahav, Rosenboim, and Shavit (2015).

One key concern is that these results may not be generalizable to the non-college population. However, one preliminary indication that these may have external validity comes from Magistro (2019). More specifically, she measures SDRs in the same way as they are measured here and looks at the relationship between SDR and financial and economic literacy in the general population[9], expecting financially and economically literate individuals to have lower discount rates and hence

[9]Financial and economic literacy is measured through a series of questions on basic financial concepts, such as the working of interest compounding, the difference between nominal and real values, and the basic risk of diversification, and questions on country-specific knowledge on certain policies and on their inherent trade-offs.

Table 3

	DV: Subjective Discount Rate		
	Robust	Robust and Resistant	OLS (excluding outliers)
	(1)	(2)	(3)
Fin/Econ *after* (Poli Sci *after* ref. category)	−0.649***	−0.406***	−0.377***
	(0.097)	(0.079)	(0.081)
Age	−0.052***	0.008	0.013
	(0.016)	(0.013)	(0.013)
Male (Female ref. category)	−0.119	−0.138*	−0.169**
	(0.094)	(0.077)	(0.079)
Income $25,000 - $49,999 ($0 - $24,999 ref. category)	0.870***	−0.166	−0.220
	(0.178)	(0.146)	(0.172)
Income $50,000 - $74,999	−0.004	−0.018	−0.056
	(0.190)	(0.156)	(0.169)
Income $75,000 - $99,999	0.088	0.049	0.072
	(0.167)	(0.137)	(0.137)
Income $100,000 - $124,999	−0.050	0.019	0.057
	(0.152)	(0.125)	(0.125)
Income $125,000 - $149,999	−0.084	−0.083	−0.098
	(0.189)	(0.155)	(0.158)
Income $150,000 - $174,999	−0.149	−0.168	−0.171
	(0.176)	(0.144)	(0.152)
Income $175,000 - $199,999	−0.319	−0.249	−0.262
	(0.200)	(0.164)	(0.170)
Income $200,000 and up	−0.065	0.022	0.007
	(0.158)	(0.129)	(0.127)
Constant	1.917***	0.467*	0.364
	(0.320)	(0.262)	(0.276)
Observations	93	93	79
Residual Std. Error	0.250 (df = 81)	0.342 (df = 81)	0.316 (df = 67)
F Statistic			3.281*** (df = 11; 67)
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 4

	DV: Subjective Discount Rate		
	Robust	Robust and Resistant	OLS (excluding outliers)
	(1)	(2)	(3)
Fin/Econ *before* (Poli Sci *before* ref. category)	−0.654	−0.394	−0.413
	(0.536)	(0.248)	(0.320)
Age	−0.204	−0.034	−0.076
	(0.829)	(0.383)	(0.485)
Male (Female ref. category)	−0.026	−0.100	0.025
	(0.499)	(0.231)	(0.299)
Income $25,000 - $49,999 ($0 - $24,999 ref. category)	0.440	−0.074	−0.225
	(1.508)	(0.696)	(0.869)
Income $50,000 - $74,999	5.240***	22.959***	−0.351
	(1.515)	(0.699)	(0.916)
Income $75,000 - $99,999	0.683	0.474	0.718
	(1.304)	(0.602)	(0.715)
Income $100,000 - $124,999	0.675	−0.123	−0.160
	(1.284)	(0.593)	(0.722)
Income $125,000 - $149,999	0.755	−0.133	−0.323
	(1.325)	(0.612)	(0.758)
Income $150,000 - $174,999	−0.206	−0.426	−0.243
	(1.466)	(0.677)	(0.811)
Income $175,000 - $199,999	0.060	−0.095	0.011
	(1.547)	(0.714)	(0.852)
Income $200,000 and up	0.652	0.057	0.318
	(1.243)	(0.574)	(0.693)
Taken Econ before Yes (No ref. category)	−0.607	−0.245	−0.589*
	(0.507)	(0.234)	(0.295)
Constant	5.183	1.749	2.819
	(14.879)	(6.870)	(8.699)
Observations	91	91	78
Residual Std. Error	1.764 (df = 78)	1.023 (df = 78)	1.217 (df = 65)
F Statistic			1.076 (df = 12; 65)
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 5

	DV: Subjective Discount Rate		
	Robust	Robust and Resistant	OLS (excluding outliers)
	(1)	(2)	(3)
Poli Sci *before* (Poli Sci *after* ref. category)	0.183	0.133	0.014
	(0.453)	(0.545)	(0.356)
Age	−0.189	−0.101	−0.159
	(0.203)	(0.245)	(0.160)
Male (Female ref. category)	0.048	−0.183	−0.238
	(0.390)	(0.469)	(0.321)
Income $25,000 - $49,999 ($0 - $24,999 ref. category)	3.185***	2.217**	0.976
	(0.782)	(0.941)	(0.656)
Income $50,000 - $74,999	0.174	0.107	0.085
	(0.866)	(1.043)	(0.666)
Income $75,000 - $99,999	0.174	0.272	0.271
	(0.748)	(0.900)	(0.567)
Income $100,000 - $124,999	0.138	20.381***	0.014
	(0.706)	(0.850)	(0.545)
Income $125,000 - $149,999	−0.641	−0.467	−0.586
	(0.840)	(1.012)	(0.654)
Income $150,000 - $174,999	−0.110	−0.587	−0.631
	(0.813)	(0.979)	(0.658)
Income $175,000 - $199,999	−0.050	0.344	0.394
	(0.808)	(0.972)	(0.595)
Income $200,000 and up	0.213	0.383	0.055
	(0.694)	(0.836)	(0.533)
Constant	4.613	2.889	4.074
	(3.953)	(4.760)	(3.126)
Observations	84	84	69
Residual Std. Error	1.079 (df = 72)	2.075 (df = 72)	1.150 (df = 57)
F Statistic			0.931 (df = 11; 57)
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 6

	DV: Subjective Discount Rate		
	Robust	Robust and Resistant	OLS (excluding outliers)
	(1)	(2)	(3)
Fin/Econ *after* (Fin/Econ *before* ref. category)	−0.461***	−0.152***	−0.132***
	(0.149)	(0.057)	(0.036)
Age	0.001	−0.017*	−0.001
	(0.026)	(0.010)	(0.006)
Male (Female ref. category)	0.041	0.044	0.022
	(0.130)	(0.050)	(0.031)
Income $25,000 - $49,999 ($0 - $24,999 ref. category)	−0.171	0.193	−0.044
	(0.336)	(0.129)	(0.079)
Income $50,000 - $74,999	1.654***	3.871***	0.012
	(0.317)	(0.122)	(0.075)
Income $75,000 - $99,999	0.021	−0.014	0.007
	(0.277)	(0.107)	(0.065)
Income $100,000 - $124,999	−0.128	−0.043	−0.001
	(0.259)	(0.100)	(0.061)
Income $125,000 - $149,999	0.567**	0.008	0.062
	(0.276)	(0.106)	(0.069)
Income $150,000 - $174,999	−0.305	−0.107	−0.044
	(0.303)	(0.117)	(0.069)
Income $175,000 - $199,999	−0.255	−0.023	0.045
	(0.380)	(0.146)	(0.082)
Income $200,000 and up	−0.112	0.018	0.022
	(0.259)	(0.099)	(0.061)
Constant	0.647	0.580***	0.226*
	(0.523)	(0.201)	(0.116)
Observations	100	100	77
Residual Std. Error	0.439 (df = 88)	0.257 (df = 88)	0.128 (df = 65)
F Statistic			2.352** (df = 11; 65)
Note:			*p<0.1; **p<0.05; ***p<0.01

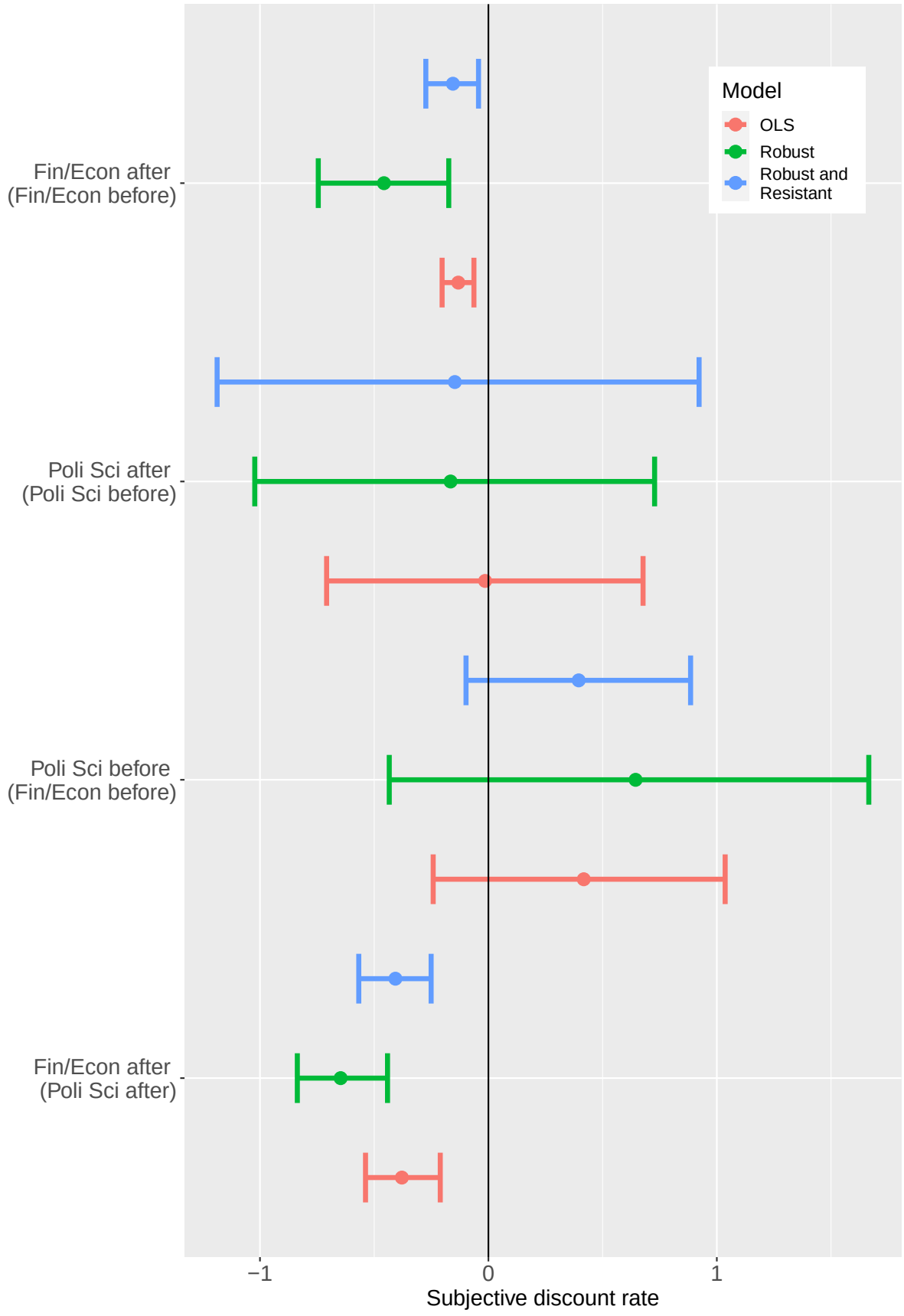

Figure 1: First differences of mean subjective discount rates between groups. Bars indicate the 95% confidence interval.

to be more patient. Indeed, she finds that financially literate people among the general population have significantly lower SDRs and the mean and standard deviations found in the sample are very similar to the ones found here for college students.

6 Conclusion

Although multiple works in political science, economics, and psychology show that discount rates affect individual behavior, the literature has been relatively silent on factors that form and potentially change subjective discount rates. Can people become more patient? The answer to this question is of utmost importance for understanding many individual choices involving intertemporal trade-offs with long-term implications: from financial decisions to public policy decisions on pensions, free trade, immigration, debts and deficits. In this paper I investigate the effects of financial literacy on time preferences and find that learning financial concepts like the time value of money significantly reduces subjective discount rates across a group of college students, effectively making them more patient. Furthermore, departing from past studies, I attempt to address some potential endogeneity issues. Although previous studies (Lahav, Rosenboim, and Shavit, 2015) confirmed that finance students' subjective discount rates decrease upon learning basic capitalization, they did not address the possibility that there may be a selection effect of students choosing to pursue financial studies, and that more schooling in general may decrease subjective discount rates (Becker and Mulligan, 1997). To address these issues I introduce control groups of students enrolled in political science classes, who have not taken any economics or finance classes, and who hence should not have been exposed to concepts like the time value of money. I first test whether freshmen who decide to enroll in economics have SDRs significantly different from those of freshmen choosing to enroll

in political science classes (specifically introduction to political theory), and I find that there is not a significant difference between the two, suggesting that there is not a selection effect into economics/finance. Second, I test whether SDRs are lower after taking any college class, or whether the decline is specific only to students acquiring financial literacy. Findings suggest that SDRs are dramatically lower for students learning about the time value of money, as there is a significant difference in SDRs between freshmen enrolling in economics and students who have just finished a finance class, where they learned about basic capitalization. Conversely, there is not a significant difference in SDRs between freshmen deciding to enroll in political science at the start of their college career, and students who have finished a political science class.

These findings have implications for the economics, psychology, and political science literatures studying the relationship between patience and individual behavior, and for financial education programs and campaigns. Previous studies show that people with lower SDRs and financially literate people have better financial outcomes and make savvier savings and investment decisions. If indeed learning concepts like the time value of money dramatically decreases SDRs, then financial education programs have the potential to bring substantial benefits to its recipients, and possibly to society as well, since in situations where policies with intertemporal trade-offs are under consideration, financially literate individuals with lower SDRs may be more patient and willing to favor policies with net long run benefits and net short run costs.

Further research is needed to investigate whether these effects are indeed generalizable to the non-college population and most importantly, it should be tested whether these effects are long-lasting or whether they disappear quickly after having learned the concepts in question.

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