Full Title

The effect of economic situation on time and risk preferences: Does financial literacy matter?

Short Title

Economic preferences and financial literacy

Author list

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Author contributions

MA and MM conceived the main idea, theoretical framework, and design of the study. IR and MA performed the statistical analyses. All authors have revised the manuscript, made a substantial contribution to this work, and approved it for publication.

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Abstract

Socioeconomic status is considered to have an effect on one's economic decision-making, inducing more myopic preferences in poor people. The relationship, however, might not be that straightforward, as economic decision-making should also be determined by financial literacy. Employing a pre-registered cross-validation procedure, we tested a structural model outlining a causal mechanism of relationships between poverty, its perception, financial literacy, and economic decision-making in terms of time-discounting and risk preferences. Even after respecifying the model in the exploratory dataset, the confirmatory analyses showed mostly weak or inconclusive relationships, suggesting that time-discounting and risk preferences are rather stable traits, almost independent of one's long-term economic situation, its perception, and financial literacy. The results suggest that financial literacy seems not to be on the causal pathway linking economic situation and economic preferences.

Key words: economic situation; poverty; subjective socioeconomic status; time-discounting; risk preference; financial literacy.

Introduction

There exists a prevailing notion that people living in poverty have rather specific economic preferences in terms of intertemporal choice and willingness to take financial risks. For instance, people with low socioeconomic status¹ are said to make more myopic decisions (e.g., prefer small immediate rewards instead of waiting for bigger ones; [1,2]). Such behavior makes sense as living under the conditions of poverty is associated with more pessimistic economic expectations towards future [3,4]. Poverty also affects both cognitive and affective processes (e.g., induces stress, impairs working memory) which consumes capacity for decision-making (see e.g., [5-7]), possibly resulting in a more impulsive behavior. After a closer examination, however, one can argue that the effect of economic status on economic decision-making on the individual level is small or unambiguous (e.g., [8]).

What if there is another, often omitted, variable that consequently mediates the effect of economic situation on economic preferences? Like financial literacy. For instance, poor people tend to be aversive to financial risks and often disregard the benefits of investment (see [9]). Such attitudes could be shaped by having knowledge of principles underlying financial processes. If there is indeed a causal pathway where economically less rational decisions are mediated by financial literacy (i.e., financial literacy can mitigate detrimental effect of poverty on decision-making in a way that despite being poor, a person with higher financial literacy will prefer economically more rational choices and will behave contrarily to the Framing effect in the Prospect theory), it could mean a substantial shift in policy making and intervention programs. Those, instead of directly alleviating poverty, could aim to enhance one's economic decision-making competencies, making the fight against poverty perpetuation more effective. Despite the increasing number of studies that focus on similar issues (e.g., the effect of financial education on financial behavior; for a meta-analysis of experimental studies see [10]), hitherto, a surprisingly small number of studies tackled the described problem either theoretically or empirically. To our knowledge, in the only empirical papers [11-13] directly combining income, financial literacy and economic decision-making, the authors found that financial literacy decreases time-discounting although the effects are rather small. Other than that, a recent review [5] presented a hypothesized complex model of a cognitive mechanism describing how can poverty affect economic preferences. The authors, however, did consider financial literacy only as a covariate of economic preferences, neglecting the possibility that financial literacy can

¹ Given the vagueness in poverty definitions, we also use the term low socioeconomic status to refer to the conditions of poverty

be directly affected by economic status. In the present study, we aim to investigate whether financial literacy mediates the effect of economic situation on economic preferences, accounting for other likely relevant variables (such as negative affect, working memory, etc.) that can confound the proposed relationship.

Poverty, economic preferences and financial literacy: What do we know so far?

It is difficult to properly determine what poverty is – since, somewhat naturally, there exists no consensus on what it means to be poor. The World Bank [14] defines poverty as a multidimensional concept encompassing monetary aspects (i.e., lack of resources or insufficient income) and subjective assessment of poverty in terms of one's well-being. Living in conditions of poverty is accompanied by a whole spectrum of characteristics, commonly carrying a negative valence. Having liquidity constraints is associated with impaired mental health [15-17], unpleasant social outcomes [18] or deteriorated cognitive functions [19]. All of that can lead to poverty perpetuation, though to investigate a more direct path, we will focus on economic decision-making.

In general, people are prone to biases when making decisions, often related to financial matters (for a review of biases often present in future-oriented decisions see [20]). But do we know how exactly does socioeconomic status, and especially its extreme in the form of poverty affect one's economic decision-making? And can we really consider myopic decision as biased or could they have an evolutionary adaptive function (see Risk-sensitivity theory [21])? Economic decision-making often refers to situations when an individual has to make a decision evaluating present-future trade-offs and/or considering for uncertainty. It encompasses a broader range of different processes, for example, time-discounting, risk-taking, saving, borrowing, stock market decisions, etc. We decided to further investigate only time and risk preference as, in line with Kraay and McKenzie [22], we believe they play a crucial role in poverty perpetuation. A connection between time-discounting (impulsive behavior) and risk-taking is proposed by several theoretical models (see, e.g., [23]; the salience weighted utility over presentations model [24]; the generality of deviance framework [25]). Although some authors (e.g., [26]) deem time and risk preferences as distinct constructs, many recent field or laboratory experiments confirm the link between the two (e.g., [27-29]).

Time preference can be defined as an individual's willingness to wait for an outcome depending on the time it takes to reach it [30]. It is considered, together with risk preference, to be a stable personality trait [31,32]. In terms of financial outcomes, high-discounting people aim for smaller but immediate rewards instead of waiting for larger ones. Time preferences are associated with many economic behaviors, such as credit-card debt, where present-biased individuals borrow more [33], or with wealth, where those with higher discount rates possessed fewer assets [34]. There exists a large body of evidence on potential predictors of such behavior (for reviews see [5,30]). To mention a few, it is associated with cognitive load, impulsivity, or impaired cognition in general, all of which can be also linked to states of economic deprivation.

When facing uncertainty, people can often choose between playing it safe and taking a risk. Risk preference reflects one's inclination towards the riskier alternative even though the unwanted outcome is equally or even more likely to happen relative to the potential gains. Although risk preference is considered to be a cognitive judgement [35], many kinds of emotions such as fear, optimism, or regret influence risk-taking [36]. Briefly, positive emotions decrease risk-taking [37] and negative emotions increase it [38]. Although unwillingness to take economic risks in situations of gain is regarded as a universal trait [39,40], it is even more noticeable in people living in poverty (see, e.g., [41-43]), as in this case, regardless of the intrinsic risk-seeking preference, even a small reward can alleviate their misfortune. This kind of behavior can be seen as adaptive, what is in accordance with the Risk-sensitivity theory [44]. On the other hand, for example, Mishra and Lalumière ([45], p. 609) found that people „exhibited elevated risk-preference when they were placed in a situation of high need“. This can explain, why poor people are more likely to play the lottery [46]. When the situation involves potential loss instead of reward, Adamkovič and Martončík [5] hypothesize that, in line with the Prospect theory [47], poor people will more likely settle for taking a risk. This is so because in their case, the chance of avoiding a potential loss is subjectively more beneficial compared to negative feelings of the undesired outcomes.

With respect to psychological aspects of decision-making, former decision-making theories (i.e., Rational Choice Theory) neglected the influence of psychological variables, hence idealizing the decision-maker as “a perfectly rational cognitive machine” ([48], p. 1755). Therefore, so proclaimed cognitive biases such as time-discounting or risk aversion can make perfect sense from a more global perspective. If one takes into account the theory of Ecological rationality [49] and focuses more on the context rather than the strict logic, such “fallacies” instantly become functional from the evolutionary perspective. For example, if one suffers from liquidity

constraints it makes sense to grab what is at disposal and saturate the basic needs disregarding the potential gains in a shaky future.

The implicit assumption that living in the conditions of poverty promotes less rational (more myopic) economic decision-making appears to have a strong support in the existing evidence. After a closer examination, however, one will find evidence supporting the hypothesis mostly on a country-wise level (e.g., [8,50]), and even in this case, the effect is medium at best. In a global preference survey, Falk et al. [8] showed that between-country variation can explain 14% and 9% of the variance in time preferences and risk-taking, respectively. On an individual level, after controlling for the country effect and the inclusion of other covariates such as age, gender, religion, or subjective evaluation of math skills, the effect of household income on both patience and risk-taking was small ($\beta = 0.04$ and $\beta = 0.06$). Likewise, Reimers, Maylor, Stewart, and Chater [51] reported a correlation of $-.09$ between income and delayed choice preference. Using an experimental design, Carvalho, Meier, and Wang [52] showed that liquidity constraints were associated with more myopic decision-making when a financial reward is involved, but in addition, they found a nearly null effect of acute liquidity constraints on risk-taking. Another somewhat similar study [53] indicated that formal savings of the poor, and hence their subjective feeling of financial stability, led to a 4% increase (i.e., 0.12 SD) in risk-taking frequency and a maximum of 5% increase (i.e. 0.11 SD) in their delay of gratification relative to controls. A markedly bigger effect of poverty was found by Brown, Ivković, and Weisbenner [54]. They reported that, conditional on factors such as financial literacy or expectations towards the future, people who rated their liquidity constraints as important were 21% more likely to choose the more immediate reward. Although they controlled for relevant variables, the effect might be inflated relative to general preferences as their research was conducted on a sample of retirees. Besides that, we found no more papers we consider eligible to directly answer the question whether poverty (in a long-term perspective, not as an income shock) affects individual time and risk-taking preferences in monetary outcomes or not. The existing evidence implies several points: (1) most importantly, the notion that poverty leads to myopic financial decision-making might not be as solid as often presented, at least on the individual level; (2) the relationship between socioeconomic status and both time and risk preference may be nonlinear, meaning there might exist a transitive interval in one's economic situation after which the relationship between the two practically ceases to exist; (3) it might be not a long-term socioeconomic situation but rather urgent financial hardship that affects one's economic preferences; (4) the relationship is in reality too complex with too many variables, either contextual (e.g., immediate

expenditures) or dispositional (e.g., self-control capacity), which can affect it and which should be considered in research design; (5) evaluation of the relationship is difficult as there's relatively little evidence to provide for a stable meta-analytic estimate and consequently, potential moderators cannot be investigated.

One of the major factors that can explain economic preferences of an individual is their financial literacy. The term financial literacy started to be used in the literature only in recent decades, but the usage of the concept in research is on the rise [55]. In a broader perspective, financial literacy can be defined as one's ability to process economic information and make sensible choices when economic decisions are involved [56]. The construct comprises three facets related to financial behavior, namely, knowledge, skills, and capability. Despite this fact, it is usually only financial knowledge that is assessed in practice [57]. A substantial body of evidence documents low financial literacy worldwide [58] and especially in low-income households [59]. Many programs that aimed to increase financial literacy, and consequently to improve financial behavior had been proposed in the last years. However, the recent evidence [10-12,57,60] showed that financial education has only a small effect on financial literacy and almost negligible effect on real-life financial behavior. At the same time, the duration of these effects is very limited, often lasting no longer than one year [57,61]. In practice, the needs of financial literacy vary under different conditions. One of them is socio-economic status [62]. There exists evidence that financial knowledge starts being determined as early as childhood [63]. Specifically, Grohmann, Kouwenberg, and Menkhoff [64] outlined a possibility that childhood experiences in terms of family background, schooling, and financial socialization (i.e., the process of shaping financial knowledge and behavior in childhood) determines financial literacy in later life. As discussed by Lusardi and Mitchell [59] because of limited resources, low-income people have limited need and access for formal financial education. In other words, for poor people, it is relevant to acquire some basic notions, but they find no use in learning more complicated concepts such as risk-reward trade-offs. However, people with higher financial literacy save and invest more [65-67] and create emergency funds or accounts [67-69]. A recent lab experiment [13] showed that an increase in financial literacy amplifies the tendency to wait for delayed higher rewards. Similarly, Meier and Sprenger [70] and Ottaviani and Vandone [71] found that impulsive / less patient individuals have lower levels of financial literacy.

Altogether, the previous research on this topic suggests three causal pathways: 1) socio-economic situation determines financial literacy; 2) socio-economic situation can determine financial decision-making; and 3) financial literacy determines financial decision-making. Taking

this into account, there arises a need to delve into this system of relationships and examine whether financial literacy mediates the relationship between poverty and economic decision-making.

Rationale for choosing the model to test

Synthesizing the existing evidence, we propose to test the following model (see Figure 1):

Objective economic situation affects one's subjective evaluation of socioeconomic status.

Moreover, the objective economic situation directly influences financial literacy, whereas we suggest that, conditional on objective economic situation, there is no causal pathway between subjective socioeconomic status and financial literacy. All of the aforementioned variables have an impact on one's economic decision making. To be more concrete, we hypothesize that general wealth of family or household the person lives in affects the person's subjective evaluation of socioeconomic status. Both objective and subjective poverty can potentially regulate financial decision-making process - if one is scarce, or perhaps even more importantly actually feel being scarce on resources, they will discount more, will be risk-averse when reward is involved, and on the contrary, will be willing to take more risks in situations of potential loss since such behavior would perfectly correspond with the theory of ecological rationality. The perpetual experience of poverty can impair financial literacy/financial management skills as one has had fewer possibilities and almost no need for self-education or improvement in such abilities. It is then financial literacy that can henceforth lead the person to make economically irrational or unfavorable decisions. We consider important to highlight the fact that the relationship between poverty and economic-decision making might be subjected to too many moderating factors. In the present design, we decided to control for several variables including negative affect, perceived stress, self-control, working memory, self-evaluated poor delay of gratification, intuitive/deliberative style of thinking, frugality, spendthrift/tightwad, and perceived reliability of the environment (the last 3 variables were available only in the confirmatory dataset).

Since researcher degrees of freedom in the analytic workflow can markedly influence the results, we highlight several points: (1) Starting from the poverty operationalization, we believe it is needed to distinguish between objective economic situation and its subjective evaluation. It appears that it is the subjective evaluation that has a larger effect on one's financial decisions [19,53,72]. Furthermore, even though we often use the term poverty, we attempt to investigate a

model that treats the economic situation as a continuous variable, as any sort of dichotomization (such as poor vs. non-poor) discards information present in the data. For example, most of the research uses some threshold, dichotomizing people only by income into those under and over the “poverty line”. But is there a substantial reason to do so? If we define poverty line to be 60% of median personal income in the country (which is widely used threshold but has only very vague rationale in economic literature), will the proposed model hold true for a person who gains 59% of the median but not for one who is at 61%? To overcome the outlined issue, we aim to combine both approaches regressing subjective evaluation of socioeconomic status on household income as an objective indicator. Another major problem related to poverty research is range restriction (see, e.g., [73,74]). That is working only with poor people or restricting the sample to people within a certain income range (e.g., focusing only on people with income less than 60% of median income), a specific gender, age, or with specific personality traits. Homogeneity of a sample (the sample is more homogeneous than the population from which it comes from) is in this case (often mistakenly) advocated as an advantage, whereas in fact, it reduces the variance of measured variables. To preserve the full range of variances of the measured variables, we stick to conducting the research on a sample representing the whole population regardless of any widely used cut off points.

(2) One can also dispute a decision to encompass financial literacy as a mediating variable. Although mediation analysis is often poorly conducted [75] and has several caveats (see, e.g., [76]) especially when using observational data which tend to produce biased estimates [77], we believe the proposed model composition is fully legitimate. Even though the nature of the research question does not allow to draw strong causal inferences, we argue financial literacy is driven by one`s objective economic situation (associated with the level of education) and financial opportunities (see [63,64]) and subsequently can determine one`s economic choices. From this perspective, an alternative model in which financial literacy will be considered as a moderator independent of the economic situation does not make that much theoretical sense. Moreover, including it as a covariate will fail to answer our research question and will also neglect the theoretically plausible causal structure. One could argue that the causality between objective economic situation and financial literacy is, in fact, reversed - that one`s economic situation depends on financial literacy. We argue that this is less plausible (but of course still possible) as financial literacy is a set of knowledge acquired through (mostly formal) education and experiences and thus depends on one`s objective economic status. Also, financial literacy

per se cannot affect one's economic situation as the causal flow between financial literacy and economic situation is blocked by the actual economic decision-making.

(3) There exist also several options for operationalization and the actual measurement of economic decision-making. Since it is probably not possible to capture economic decision-making in its full complexity, we decided to focus on its core aspects that are important in poverty perpetuation – dealing with present-future trade-offs and uncertainty. We hypothesize the patterns of economic decision-making we have already depicted (e.g., preference for certainty in situations of gain and tendency to risk when loss is involved), falls along a single latent variable. Furthermore, a recent Staircase model of time and risk preferences [78] surpasses the possible inconsistency of existing measures and should allow for more valid representation of one's economic preferences.

Methods

Preregistration of the study can be found at <https://osf.io/7gczq/>.

Data collection, participants, and power analysis

Two datasets (exploratory, $N = 430$; confirmatory, $N = 500$) were collected in order to test the proposed model. All the participants were recruited via a local (Slovak) agency specializing in data collection and market research, which works similarly to Amazon Mechanical Turk. All the materials were administered online, and each participant provided agreement with the informed consent. After completing the study, the participants received a compensation in the form of credits that could be spent on the various products offered by the agency. The study was approved by the ethics board of the Institute of Psychology (University of Presov). The data used in this study were collected as a part of a bigger data collection for the research grant APVV-15-0404 "Psychological causes and consequences of poverty". The data were collected on a large-scale sample ($N_{total} = 930$; Female = 50.3%) of Slovak adults in productive age (ranging from 18 to 60 years; mean age = 39.8; $SD = 11.7$). In the time of data collection, 63% of the total sample had at least a part-time job or were self-employed, 7% were unemployed, 8% considered themselves as full-time students, 23% were either retirees, been receiving a disability support pension, and the remaining 9% chose the option "other". A maximum of primary education was achieved by 3% of the sample, 63% of the sample finished their

secondary education, and approximately 34% acquired an academic degree. Due to the requirements of other studies which data were collected simultaneously, 214 and 210 participants living under the poverty line (income less than 60% of the Slovak median) were sampled for exploratory and confirmatory datasets, respectively. After the initial screening for the careless responders using longstrings (see [79]) and analyzing the open-ended questions, 11 participants from the exploratory and 14 participants from the confirmatory dataset were excluded from the analyses. One additional participant from the confirmatory dataset was omitted from the analyses as the majority of her responses went missing, due to a technical error in recording since other than that, no missing data were in the dataset as the request entry utility was employed in the administration process. The resulting sample sizes were 419 participants in the exploratory and 485 participants in the confirmatory dataset, respectively.

The initial sample size was determined based on the financial constraints of the research team. Both samples had sufficient statistical power to detect even small effects (we consider $r = .2$ to be our smallest effect size of interest). *RMSEA*-based power analysis ($\alpha = .05$; H_a *RMSEA* = .08; H_0 *RMSEA* = .04; see [80]) of the proposed structural model (see Fig 1) showed more than 99% power to detect a causally misspecified model. The power still converged to 1 even after the sample sizes in both datasets were reduced.

Measures

Economic situation. Objective economic situation was measured as a monthly household net income transformed in accordance with a slightly revised OECD modification scale [81]. Our formula assigned a coefficient of 1 to the household head, .5 to each additional adult member and .3 to each child. In the actual analyses, the income was divided by 100 to reduce its variance. Subjective poverty was measured by 3 indicators: (1) Subjective perception of socio-economic status (The MacArthur scale of subjective social status; [82,83]); (2) The mean score of the created 6-item 5-point scale of wealth satisfaction (e.g., “Are you satisfied with your monthly income?”, or “Are you able to handle unexpected financial expenses?”; $\omega_{\text{total}} = .92$ for both exploratory and confirmatory datasets); and (3) own perception of poverty/wealth (You consider yourself as: 1 = poor; 5 = neither poor nor rich; 9 = rich).

Financial literacy. In the first data collection, 3 basic and 3 advanced questions [84] for assessing financial literacy were used. Two additional advanced questions were included into the second data collection as the data screening after the first data collection showed a

negatively skewed distribution, meaning the original set of questions were probably too easy for the participants.

Economic decision-making. The factors of economic decision-making were assessed as follows: Time-discounting was assessed via the Staircase model proposed [78]. Due to the non-normal distribution (the distribution had several spikes), we settled for including 27-Item Monetary Choice Questionnaire [85,86] as an additional measure in the second data collection. Risk preference in case of reward and also in case of loss were, too, assessed using the model by Falk et al. [78], however, taking into account the Prospect theory and loss aversion tendency, we modified the measure in which loss was involved by reducing the presented amount of money to half in order to attenuate the experiencing of loss. In both data collections, time/risk preference questionnaires preceded the financial literacy measure. Several other measures (e.g., digit span test, Perceived Stress Scale, etc.) were administered in between the time/risk preference and financial literacy questionnaires.

Descriptive statistics for these measures can be found in Table 1.

Table 1. Descriptive statistics

	Exploratory dataset				Confirmatory dataset			
	Mean	SD	Skew	Kurtosis	Mean	SD	Skew	Kurtosis
Income	5.61	2.95	1.34	3.90	6.06	3.28	1.44	4.68
SES	5.03	1.69	-0.13	-0.02	4.75	1.60	0.04	-0.12
ECO	2.92	0.78	-0.16	-0.15	2.87	0.79	-0.14	-0.45
Wealth	4.64	1.41	-0.64	0.65	4.66	1.45	-0.57	0.68
FL	3.75	1.60	-0.28	-0.85	4.29	1.88	-0.15	-0.68
TD	18.23	10.70	-0.42	-1.31	17.45	10.91	-0.31	-1.46
RR	8.66	7.48	1.36	1.34	8.75	6.74	1.09	0.85
RL	21.56	7.70	-0.75	0.53	22.02	7.00	0.23	0.23
TD2	-	-	-	-	0.03	0.06	2.74	6.73

$N_{exp} = 419$, $N_{conf} = 485$; Abbreviations: Income = equivalized household income in euros per month (objective economic situation); SES = subjective perception of socioeconomic status

(range 1-10; a higher number indicates higher status); ECO = subjective perception of financial situation (range 1-5; a higher number indicates higher satisfaction); Wealth = perception of own wealth (range 1-9; a higher number indicates more wealth); TD = time-discounting (range 1-32; a higher number indicates higher time-discounting); RR = risk preference when reward is involved (range 1-32; a higher number indicates higher risk preference); RL = risk preference when loss is involved (range 1-32, a higher number indicates higher risk preference); TD2 = second measure of time-discounting (number indicates the rate of discounting).

Analysis

The hypothesized structural model was first tested against the exploratory dataset. At this point, any model misspecifications were carefully studied and possibly addressed. The respecified model was then fitted to the confirmatory dataset in order to establish whether the changes to the model cross-validate. All the latent models were estimated in R package lavaan [87] using the Weighted Least Squares Means- and Variance-adjusted fit function, while explicitly modelling the ordered nature of the endogenous indicators.

Models were seen as falsified based on a significant value of the χ^2 test statistics (see [88]). Had the hypothesis of the exact fit of the model to the data been rejected, the next step consisted of careful diagnostic procedures to assess whether the given model can be regarded as a reasonable approximation to a model that would fit the observed data exactly. For the assessment of global model fit, we employed the following scaled approximate fit indices, *CFI*, *TLI*, *RMSEA*, and *SRMR*. To examine local sources of model misspecification, we examined the matrix of residuals.

In order to be able to assess the degree of comparative evidence for the target structural coefficients, we also calculated approximate Bayes factors. Bayes factors (*BF*) show whether there is comparative evidence either for H_a (effect present) or H_0 (effect absent), i.e., whether the data are more consistent with H_a , H_0 , or inconclusive. Each *BF* thus represents the relative evidence in the data favoring alternative hypothesis (parameter freely estimated) over the null (the given parameter fixed to 0). Frequentist approach without specific procedures (e.g., equivalence testing), on the other hand, cannot provide evidence for H_0 , by definition (the only possible conclusions are H_0 being rejected or failed to be rejected). Here estimated *BF* were based on model selection/information criteria approach as proposed by Wagenmakers [89], that is, employing *BIC* approximation that implicitly assumes unit information prior. That makes them

rather conservative with respect to the alternative hypothesis. Apart from *BF*, we also estimated the respective posterior probability of each of these parameters. Posterior probability refers to the probability of the parameter not being zero (as opposed to probability of the data under a null). The estimation of posterior probability assumed a 1:1 prior odds of H_0 and H_a being true, respectively.

The entire analytic pipeline (data handling and analyses) reported in this paper is fully reproducible. Data, R code, and analytic outputs are freely available at <https://osf.io/amwq3/>. The analysis was preceded by data screening looking for careless responders (i.e., those with the relative length of the longest string of identical consecutive responses of $> 2.5 SD$ who also provided careless answers on the open questions throughout the whole test battery), mistyped or improbable values, as well as the visualization of the variables (examining especially kurtosis). None of the subjects was considered an outlier and no data transformations were applied.

Deviations from the preregistration protocol

While writing the introduction, we had further discussed the best possible ways of analyzing the data. Hereby, we would like to highlight 3 deviations from the preregistration document. (1) Although financial literacy has more than 5 items, we decided not to make parcels of them but to model every item instead; (2) instead of running several models with a different configuration of covariates, we decided to include all covariates into one model; (3) in the preregistration, we mention that time-discounting in situations of loss was measured in the second data collection. However, due to an error in the scoring procedure biasing the results, the measure was not used in the analysis.

Results

Note that due to the better legibility, we refer to the facets of economic decision-making using abbreviations as follows: time-discounting = TD; risk preference when reward is involved = RR; risk preference when loss is involved = RL.

Exploratory model testing

Before proceeding to testing the target structural model, we tested whether the construct of financial literacy (as measured by 6 indicators) could be regarded as unidimensional. A model with all the indicators loading on a single latent construct fitted the data well with $\chi^2(9) = 12.91$, $p = .17$; $CFI = .99$, $TLI = .98$, $RMSEA = .03$, 95% CI [.00, .07]. Regarding financial literacy as measured by multiple items as a trait that falls along a single latent continuum thus seemed to be supported by the present data. The reliability (internal consistency) estimates for financial literacy and subjective poverty were $\omega_{\text{total}} = .81$ and $.85$, respectively.

In the next step, we tested the fit of the full structural model. The three endogenous latent variables, economic decision-making, financial literacy, and subjective socioeconomic status were regressed on the possibly confounding variables, namely negative affect, perceived stress, self-control, working memory, self-evaluated poor delay of gratification, and intuitive/deliberative style of thinking, which thus acted as model covariates. The a priori estimate of statistical power based on the *RMSEA* distribution showed that with the given sample size and the complexity of the predicted model, the probability of a substantially misspecified model, being flagged by *RMSEA* of $> .08$, converged to 1.

The model test indicated a beyond-chance deviation of the hypothesized model from the observed data, with $\chi^2(115) = 222.89$, $p < .001$, and the following approximate fit indices $CFI = .94$, $TLI = .93$, $RMSEA = .05$, 95% CI [.04, .06], $SRMR = .07$. Although especially the upper bound of *RMSEA* did not exceed .08 (indicating a poorly fitting model), the model test result and the values of the fit indices warranted the need to look for model misspecifications. A detailed examination of the residual matrix, modification indices, and bivariate correlations indicated that the data did not substantiate the formulation of economic decision-making as a unitary construct. In fact, the local independence assumption for its respective indicators did not hold. First, there were rather substantial residuals between RR and the other two economic decision-making indicators, RL and TD, respectively. Even more importantly, the bivariate correlations between these three indicators were $-.01$, $-.07$, and $-.26$, respectively. Treating these three indicators as a measure of a common construct was thus hardly justifiable, as these three indicators clearly seemed to measure completely different and mutually independent facets of what could, in theory, be regarded important constituents of economic decision-making.

There were also some other significant residuals (see supplementary material) for that initial model, but the only change to the model we chose to do was to model TD, RR, and RL as separate outcomes and treat them as a single-indicator measures of the three respective constructs.

The respecified model lost 18 degrees of freedom due to the need to estimate structural paths to each of the three economic decision-making constructs. The model showed the following fit to the data; $\chi^2(97) = 160.93$, $p < .001$; CFI = .97, TLI = .95, RMSEA = .04, 95% CI [.03, .05], SRMR = .06. The improvement in fit was clearly significant $\Delta\chi^2(18) = 61.96$, $p < .001$. The model showed good approximate fit but was still disconfirmed by the χ^2 test. However, as there was no obvious modification that could be strongly theoretically justified and none of the suggested misspecifications seemed too serious, we chose not to alter the model any further. Namely, we aimed to be conservative with respect to the number of model respecifications and tried to make the least number of substantive modifications of the model since it is known that purely data-driven modifications usually capitalize on chance variation and consequently do not replicate [90].

All the parameter estimates for a model that does not fit exactly thus need to be interpreted with caution because it is well possible that at least some of them may be off. Regarding the parameter estimates, the estimation of the model yielded the following results: Objective economic status predicted well its subjective perception ($\beta = .41$) and was also weakly linked to financial literacy ($\beta = .16$). Objective economic status, however, didn't have any direct effect on the economic decision-making constructs, with β s of $-.04$, $.08$, and $-.09$. In fact, all these paths were non-significant, with data being 20.00, 14.29, and 5.89 times more likely under H_0 for TD, RR, and RL, respectively.

The effects of subjective economic status on the three economic decision-making facets were likewise of rather low magnitude. The path coefficients to TD, RR, and RL were $.18$, $.05$, and $-.12$, respectively. The effects on TD and RL were significant at $\alpha = .05$. Bayes factor analysis showed that there was some evidence for the effect of subjective poverty on TD ($BF_{10} = 7.96$) with the posterior probability of that path equal to $.89$. For the effect on RR, the data were rather favoring the null hypothesis ($BF_{01} = 14.29$, Posterior = $.07$). However, despite the fact that the effect on RL was significant ($p = .016$) the data were slightly more consistent with the H_0 , being 3.44 times more likely than under the alternative.

Lastly, the model included paths from financial literacy to economic decision-making constructs. Here, financial literacy has the strongest link to TD, with $\beta = .28$. Paths to RR and RL yielded β estimates of .20, and -.06, respectively. Only the former two estimates were significant. Testing for the magnitude of empirical evidence showed robust evidence in favor of the presence of an effect on TD ($BF_{10} = 19.87$, Posterior = .95). However, regarding both, RR and RL, the data were rather inconclusive or more consistent with the hypothesis of no effect (BF_{01} of 1.79 and 20, respectively).

Confirmatory model testing

To test whether the inferences drawn from testing the respecified model against the exploratory dataset cross-validate, the model was tested in an independent sample. Given the sample size and complexity of the given model, there was a high power based on the *RMSEA* distribution (converging to 1) to detect globally misfitting model. Overall, the fit of the model was practically identical to the fit in exploratory dataset (note that due to the inclusion of additional covariates and TD measure, the model has more degrees of freedom); $\chi^2(170) = 276.11$, $p < .001$; $CFI = .96$, $TLI = .94$, $RMSEA = .04$, 95% CI [.03, .04], $SRMR = .06$. Most of the substantial residuals were between the indicators (items) of financial literacy. Although the factor structure of the financial literacy latent was fitting well in the exploratory data, with factor loadings invariant to the inclusion into the full structural model, this was however not the case for the confirmatory dataset; $\chi^2(20) = 37.55$, $p = .010$; $CFI = .97$, $TLI = .96$; $RMSEA = .04$, 95% CI [.02, .06]. That fact that the fit varied across datasets calls the construct validity of financial literacy into question. Apart from the financial literacy dimension, some other minor factors undisclosed by the present design seemed to determine the variance in those items. Any inference regarding financial literacy thus need to be done with that fact in mind. Moreover, model parameters may be expected to be at least a bit off.

For the confirmatory dataset, the observed pattern of parameter magnitudes is mostly similar to the results of the exploratory phase. Objective economic situation shows a strong link to its subjective perception, moderate link to financial literacy, and no connection to TD (both measures of) RR, and RL. The effects of subjective perception of economic situation on TD, RR, and RL, were a bit stronger than in the exploratory dataset, i.e., .10, .24, and -.10, with the effect of .15 on the additional TD measure. The relative evidence in favor of the effect had been observed only for RR ($BF_{10} = 9.96$), whereas the null had been supported for both TD measures ($BF_{01} = 8.33$ and 12.5) and RL ($BF_{01} = 9.09$).

With respect to the structural effects emanating from financial literacy to TD, RR, and RL, all of the effects were rather small and either supporting the null or inconclusive. The results for the model parameters, *BF*, and posterior probabilities (note that regression estimates, *BF*s and posterior probabilities are reported only for the respecified models) are reported in Table 2 and Table 3.

Fig 1. The proposed (respecified) model and the observed standardized regression estimates

Note: Estimates for the confirmatory dataset are in parenthesis. Two additional indicators of financial literacy and an additional time-discounting measure were added in the confirmatory dataset. The initial model included one latent variable reflecting time and risk preferences instead of separate observed measures.

Table 2. Chi-square statistics and approximate fit indices for all tested models

	χ^2	<i>df</i>	<i>p</i>	<i>CFI</i>	<i>TLI</i>	<i>RMSEA</i> [95% CI]	<i>SRMR</i>
Exploratory dataset							
Financial literacy	12.91	9	.17	.99	.98	.03 [.00, .07]	.05
Initial model	222.89	115	<.001	.94	.93	.05 [.04, .06]	.07
Respecified model	160.93	97	<.001	.97	.95	.04 [.03, .05]	.06
Confirmatory dataset							
Financial literacy	37.55	20	.010	.97	.96	.04 [.02, .06]	.06
Respecified model	276.11	170	<.001	.96	.94	.04 [.03, .04]	.06

Table 3. Standardized regression coefficients, *p*-values, *BF*s and posterior probabilities for regression estimates in the respecified models

Path	β	<i>p</i>	<i>BF</i> ₁₀ (Posterior)	β	<i>p</i>	<i>BF</i> ₁₀ (Posterior)
SES ~ Income	.41	<.001	3e+13 (1)	.53	<.001	2e+25 (1)
FL ~ Income	.16	.011	14.36 (.94)	.17	.004	7.11 (.88)
TD ~ Income	-.04	.545	0.05 (.05)	-.05	.374	0.06 (.06)
TD ~ SES	.18	.001	7.96 (.89)	.10	.080	0.12 (.11)
TD ~ FL	.28	.003	19.87 (.95)	.13	.078	0.62 (.38)
RR ~ Income	.08	.201	0.07 (.07)	.01	.903	0.06 (.06)
RR ~ SES	.05	.284	0.07 (.07)	.24	<.001	9.96 (.91)
RR ~ FL	.20	.028	0.56 (.36)	.01	.854	0.05 (.05)
RL ~ Income	.09	.124	0.17 (.14)	.02	.793	0.05 (.04)
RL ~ SES	-.12	.016	0.29 (.23)	-.10	.077	0.11 (.10)
RL ~ FL	-.06	.465	0.05 (.05)	-.16	.020	0.23 (.19)
TD2 ~ Income	-	-	-	-.13	.012	0.13 (.11)
TD2 ~ SES	-	-	-	.15	.007	0.08 (.08)
TD2 ~ FL	-	-	-	.15	.034	1.34 (.57)

Abbreviations: Income = objective economic status; SES = subjective perception of economic status; TD = time-discounting; RR = risk preference when reward is involved; RL = risk preference when loss is involved; TD2 = second measure of time-discounting.

Overall, as is obvious from both phases, the only reliable and relatively strong effect was that between objective and subjective economic status. The structural relationships between the other constructs, namely subjective socioeconomic situation, financial literacy, and the three economic decision-making facets were rather unstable and overall small. The advantage of here employed split-sample approach is the ability to reveal the sheer statistical stability of the theorized structural relationships (design and operationalization of measures was identical across datasets). At the same time, the present results highlight the fact that theory building based on variable (and thus noisy) estimates of rather small sizes may be resting on shaky ground. In the present study, two of the paths associated with a posterior probability of .89 and .95 in the exploratory dataset dropped markedly in the confirmatory dataset, having a posterior probability of .11 and .38. On the other hand, a path showing only .07 posterior probability in exploratory data increased to a value of .91 in the confirmatory data. Although all other paths were reliably cross-validated, it points to the importance of empirical syntheses and the acknowledgement of uncertainty inherent in studying subtle population-level effects of this kind

Discussion

Taken altogether, the analysis yielded two main points. First, based on the χ^2 -statistics, the proposed structural model was disconfirmed by the data, despite the approximate fit indices showing a (very) good fit. Hence, we can argue that the depicted causal mechanism of how poverty affects economic decision-making through financial literacy might miss some, supposedly minor systematic factors and the results, particularly those related to financial literacy, should be viewed upon with caution. Second, contrary to the existing notions (but not to the existing empirical evidence), the obtained results of the partial relationships were mostly weak or inconclusive.

Hence, it looks like the way people deal with delaying gratification or uncertainty in economic decision-making is only marginally determined by their objective economic situation and its subjective perception. We argue that, instead of being a consequence of a time-stable situation, one's economic preferences can be considered rather as an outcome of a combination of an autonomous personality trait and temporary inclinations driven by the actual needs. To test this assumption, we ran additional analysis calculating Pearson's correlation coefficients for the three economic preference measures in participants who took part in both data collections ($N = 224$). The stability coefficients we found are moderate, all significant at the .001 level: TDR =

.41, 95% CI [.28, .52], RR = .42, 95% CI [.29, .53] and RL = .44, 95% CI [.29, .56]. In order to be valid, such explanation would require meeting two assumptions, that is, time and risk preferences are both general across domains and time-stable. Despite some suggestions that these forms of behavior are domain specific [91,92] a larger body of evidence [32,93-96] seems to favor the trait-like approach. It is, however, worth noting that stability of time and risk preference decreases over time. For long retest intervals counting in months and years, the correlations are weak to moderate but are getting stronger with shorter, weeks long, retest intervals (for a detailed review see [32,97,98]. Elaborating on our hypothesized mechanism which depicts economic preferences as a consequence of both stable traits and the actual situation, we argue that gradual natural changes in income and wealth affect one's risk preferences only marginally [99,100], but on the contrary, experiencing even a narratively induced income shock has a large effect on time-discounting [101,102]. Even though such explanation appears to be intuitive, we are unable to distinguish the approximate extent to which the two mechanisms suppress each other and influence one's economic preferences. Rather than one's socioeconomic status, there are other factors that could substantially influence the changes in time and risk preferences, such as age (i.e., risk aversion arises with age), or temporary variations in self-control or emotions (for a review see [98]).

The observed effects of financial literacy on one's economic preferences, too, do not allow to draw a clear conclusion. Again, it follows the ambiguity of the existing evidence. The general notion suggests that higher financial literacy improves economic behavior [103-106]. Some of the existing empirical evidence [70,107,108], however, show only small effects of financial literacy on economic preferences. On top of that, Fernandes et al. [57] found that after controlling for variables such as willingness to take risks, propensity to plan, or the need for cognition, financial literacy ceases to be a significant predictor of economic behavior in the majority of cases, suggesting that the "causal role of financial literacy might need revisiting..." (p. 1872). Similar conclusions can be obtained from the studies on financial education training that is hoped to improve financial literacy. For example, DeHart, Friedel, Lown, and Odum [109] found a significant, yet small effect of how participation on financial education course reduces delay discounting. A more robust and straightforward result comes from a meta-analysis [57], in which the authors claim that improvement in financial literacy explains almost zero variance in financial behavior. Likewise, in a more recent paper, Stolper and Walter [110] reviewed that the far transfer of financial literacy education on economic outcomes is very limited, but at the same time, the authors highlighted the importance of facilitating a sober economic decision-making in

general population². It seems there are other variables, such as time perspective [111], or education in general [112], which goes beyond financial literacy and have a more pronounced effect on one's economic behavior. Furthermore, the evidence questions the appropriateness of regarding the financial literacy as a mediating variable in the relationship between economic situation and economic preferences.

Taken together, it seems that external circumstances, like living in conditions of persistent poverty, but also financial literacy have only a minimal direct impact on one's economic preferences as time-discounting and risk aversion appear to be intrinsic personality traits similar to other time-invariant personality variables such as extraversion or neuroticism. This also supports the idea that it is not the socioeconomic status itself, but rather a whole causal mechanism that can influence one's economic decision-making (see [5]).

We see several caveats of this study. (1) Unexpectedly, the data shows that time-discounting and risk preferences are not caused by a single latent factor but are two practically uncorrelated constructs even though they should be sharing some level of present-future trade-offs and uncertainty. This suggests that, when referring to these constructs, we should use the higher-order term "economic decision-making" with caution, as it seems to cover both time-discounting and risk preference only linguistically (of course, conditional on considering the employed measures valid). (2). The economic decisions were bounded to hypothetical rewards. There exists a mixed evidence of whether or not a hypothetical reward can be considered an equivalent substitute for a real incentive (for a brief review see [114]). We believe it is important to test how people deal with real incentive especially in the situations of conjunction of economic decision-making and economic status. However, considering the very limited budgets for conducting a highly-powered research with relatively high incentives, this is often not feasible in practice. (3) Other limits are related to the concept of financial literacy and its measure. First, although the author of the measure herself differentiates between basic and advanced questions [84], and discusses several distinct aspects of financial literacy (e.g., knowledge, abilities, attitudes, and behavior; [115]), the measure, in fact, focuses only on financial knowledge (which is also a common practice in research on financial education; [57]). From this perspective, we highly recommend future research to be focused also on skill components and attitudes towards finances, or financial management in general, as we believe these could play

² Of course, some interventions are more effective than others. For a recent review of the effective financial education programs see a report by CFPB [113]

a more important role in the actual economic behavior [113,116,117]. Furthermore, examination of the psychometric properties of the measure showed that after the addition of two related items, the model fit got worse, putting the construct validity of the employed measure into question. Second, directly manipulating financial literacy is possible only by providing a corresponding training (which effectivity is reportedly rather disappointing) and assessing how it changes naturally throughout the lifespan is possible only using longitudinal designs with multiple data points. When only observational data are available, the causal structure involving financial literacy as an endogenous variable should be very well theoretically justified in order to be accepted. However, with respect to the obtained results, we assume that financial literacy (more specifically, objective financial knowledge as its aspect) does not play a role of a linking variable bridging economic situation and economic preferences. (4) The results could be influenced by the core socioeconomic aspects of the sample. According to the current OECD reports [118,119], Slovakia has the lowest GINI coefficient (.24; from 0 to 1, with a higher value representing bigger inequality) from all of the OECD countries, and has also one of the lowest poverty rates (8.5%). This implies that people, in general, can satiate their needs, and consequently, their economic situation or financial literacy are not the decisive factors when making economic decisions, and on the other hand, their intrinsic preferences (a trait-like approach to economic decision-making) get even more pronounced.

In the light of the present findings, we conclude that the proposed structure as a whole does not hold, and also the partial results of the effect of objective and subjective economic situation as well as financial literacy on one's economic preferences are either inconclusive or weak at the best. We hypothesize that intrinsic preferences and perhaps the momentary situation affect one's economic decision-making rather than a socioeconomic situation or financial literacy, at least in a sample drawn from a country with objectively small social inequality. Thus, the questions remain: Who is a prototype of a person with more myopic economic decision-making? And what influences one's economic preferences in a real-life environment? Considering a rather high base rate of unreplicable findings in behavioral sciences, putting the credibility of findings in question (e.g., [120,121]), such investigation requires employing the best scientific practices supported by robust crowdsourcing collaborations. Platforms like Psychological Science Accelerator [122] or StudySwap [123] can help to effectively address some of these or related questions.

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