THE DILEMMAS OF PUBLIC VS. PRIVATE GOODS DISCOUNTING FOR LONG-TERM INVESTMENT APPRAISAL: THE PUZZLE OF CITIZEN AND CONSUMER APPROACHES TO VALUATION*

Monika Foltyn-Zarychta, Ph.D., Associate Professor

University of Economics in Katowice

College of Finance

Department of Investment

1 Maja 50, 40-287 Katowice, Poland

e-mail: monika.foltyn-zarychta@ue.katowice.pl

ORCID: 0000-0002-3507-2122

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Abstract

Research background: An investment appraisal applies a single discount rate across all effects. However, this may be insufficient for heterogeneous environmental impacts, mixing private and public goods as well as use and non-use values, where individuals may have multiple intertemporal preferences due to their duality to act as consumer or citizen.

Purpose: The paper aims at identifying the scope of discrepancies in the level of discount rate for public and private as well as use-and non-use investment gains.

Research methodology: The contingent valuation method is used to elicit stated discount rates for 2 hypothetical investments: environmental or financial gains to distinguish between public and private domain accompanied by two time-frames: short (use values) and long (non-use values).

Results: The discount rate for the environment is lower than for money. It is also lower for the long-term horizon in comparison with the short-term perspective. The discrepancies are observed also for explanatory variables in respect to a socio-economic profile and attitude characteristics.

Novelty: The paper adds to the discussion on valuation discrepancies between self-interested consumers and socially oriented citizens. The scarcity of previous research examining discount rates for public/private goods as well as the short/long-time horizon make the results relevant for public policy dealing with climate change and environmental protection, providing an insight into individual intertemporal preferences.

Keywords: investment appraisal, valuation, discounting, citizen vs. consumer distinction

JEL classification: D15, D61, H43

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Introduction

Investment evaluation, when it is conducted for the purpose of financial or social appraisal, uses the criterion of net present value (NPV), where future outcomes are discounted and compared with today's outlays. Therefore, for the NPV test to be effective in supporting the decisions, we need two kind of reliable information: the value of outcomes and outlays and the discount rate. While outlays borne at present are usually reasonably easy to value, however the issue becomes far more difficult for outlays. The complexity rises both with the time as well as with certain areas of investment activities, like those affecting the public sphere. In this context, long-term environmental investments are particularly intricate, as they demonstrate a rich array of valuation and discounting issues, rarely emerging in other areas. This paper focuses on few selected issues, leaving aside such difficult tasks as i.e. dealing with high uncertainty. The considerations here concentrate on far-fetched environmental impacts, which possess three thought-provoking characteristics.

First, environmental goods are heterogeneous. They embrace use-values, that brings direct utility gains to the user and non-use values, based on altruistic motives (when an individual places a value on goods due to the fact that others use the goods), bequest motive (the value due to availability to future people) and existence value (deriving utility from the very notion that the goods exist, even if it will never be used by one) (Lazo, McClelland, Schulze, 1997; Perman, Ma, McGilvray, Common, 2003). Second, some environmental goods can be simultaneously private (rival and excludable), e.g. picking plants in a forest, or public (non-rival and non-excludable), e.g. a gene pool and biodiversity of a forest (Perrings, Gadgil, 2003). Third, the environmental impacts tend to be long-term, reaching far beyond the horizon of an individual's life (e.g. climate change, biodiversity issues, nuclear waste). It is argued that intergenerational allocations should be given a separate stance, due to the fact that future generations welfare can be perceived as public goods, non-rival and non-excludable from the point of view of people living at present (Luckert, Adamowicz, 1993; Sandler, 2009; Foltyn-Zarychta, 2018).

All three features recall a number of questions within the area of investment appraisal. Such environmental impacts possess the characteristics of public goods, which prevents the creation of the effective market, so the need of valuation arises. Additionally, as the time distance grows, the issue of discounting gains an immense weight, first, due to the absence of market rates for horizons longer than 30 years (Newell, Pizer, 2003), and secondly, due to the extremely high sensitivity of present value for small variation at a discount rate (Foltyn-Zarychta, 2018). Finally, the complex nature and intergenerational impacts of environmental goods raises

questions about the perspective of valuation: the mixture of self-regarding and other-regarding gains provokes individuals to act in a dual role as consumers and citizens and to apply two sets of preferences and attitudes for the private and social sphere separately. Lewinsohn-Zamir (1998) illustrates this discrepancy recalling Dr. Jekyll and Mr. Hyde story, where the former is an altruistic person and willing to make sacrifices for the common good (citizen) while the other maximizes egoistically personal welfare only (consumer) (cf. Sen, 1977; Sagoff 1986; Orr, 2007; Foltyn-Zarychta, Zerbe, 2019).

The examples of inconsistencies in the valuation of heterogenic goods, like environmental goods are numerous, especially in cases when the creation of a hypothetical market is involved.¹ The discrepancies arise particularly due to growing spatial or temporal distance to the good (turning use values into non-use characteristics) as well as social (public) and private features. Research shows that the value placed on goods decays with growing distance in space, which may represent use-values turning into non-use characteristics (Bateman, Day, Georgiou, Lake, 2006; Jørgensen et al., 2013; Johnston, Besedin, Holland, 2019). The speed of the decay may also differ, i.e. Hanley, Schlöpfer and Spurgeon (2003) indicate a more intense decrease for use-values. Time discounting was reported i.e. by Hardisty and Weber (2009) or Bleichrodt, Gao and Rohde (2016). The differences in valuation and discounting also emerge when public (e.g. health or environment) vs. private (monetary) gains are compared, both in terms of value of the rate, as well as its explanatory variables (Lumley, 1997; Hardisty, Weber, 2009; Weatherly, Terrell, Derenne, 2010; Berry, Nickerson, Odum, 2017). The valuations differ also when the short vs. long (intergenerational) time-frame component is taken into consideration. Such disparities were observed i.e. by Luckert and Adamowicz (1993), Meering, Bonsel, Brouwer, Stuijbergen and Essink-Bot (2010) or Almansa and Martínez-Paz (2011). Examples of discrepancies in valuation referred indirectly (via the characteristics of the goods) to the separateness of consumer and citizen perceptions, however some studies eliciting this duality explicitly bring also confirmation of the results. Mill, Van Rensburg, Hynes and Dooley (2007) indicate that when taking a citizen approach respondents tend to put similar values on various types of forests, while as consumers they differentiate their valuations. The research done by Howley, Hynes and O'Donoghue (2010) support those results. Sunstein (1996) as well as Nyborg (2000) also postulate distinguishing between consumer (*Homo Economicus*) and citizen (*Homo Politicus*).

¹ In contingent valuation the biases may also arise due to a number of other reasons, e.g. how the questionnaire is designed (question format or payment vehicle). These issues are not raised here. However, you may refer to a vast amount of research investigating the issues, i.e. Whitehead, Bloomquist (2006); Foltyn-Zarychta (2012), Boyle (2017).

However, the complexity of those valuation issues is not particularly well reflected in the canonical appraisal methods. Long-term environmental investments are usually dealt with social appraisal methods, like a cost-benefit analysis, where NPV reflects the net changes in social welfare. The discounting based on social discount rate, is designed to reflect social preferences for intertemporal allocation of welfare (Baumol, 1968). The outcomes that are not traded efficiently on the markets are valued by correcting market prices or by various valuation techniques based on surrogate or hypothetical markets (Howley et al., 2010). The literature offers various solutions to deal with the issues of finding a price for non-market goods; however a hypothetical market is used rarely for estimating the discount rate, particularly in the case of long-term frames and non-use values. Additionally, neither of the above approaches deals effectively with the consumer-citizen puzzle entangling the private-social heterogeneity and intergenerationality of environmental goods, which summons up questions about altruistic preferences towards other people.

Within an epistemological context, the paper argues that the citizen-consumer discrepancy may provide the answer for disparities in the valuation of non-market goods as well as explain the separateness of a long-term intergenerational horizon, which both appear in environmental investment appraisal. The nature of the goods affected by the investment may be described by two dimensions, illustrating the consumer and citizen roles involvements: social vs. private and use (self-centered) vs. non-use (altruistic). The empirical layer refers to the discounting, as the disparities in valuation give the grounds to claim that it is unjustified to use a single discount rate for all project effects, because, the future streams of effects, revealing their inner layer, may in essence relate to various types of benefits. The character of goods provided by the project should be considered as the intertemporal valuation may differ, depending whether the goods provide use or non-use values as well as private or social gains. Therefore, the paper aims at identifying the scope of discrepancies at the level of the discount rate for public and private as well as use-and non-use investment gains. The paper tests the hypothesis that the discount rate for environmental and monetary gains as well as use and non-use characteristics differ in terms of the value as well as explanatory variables.

1. Research Method

Deriving values and the determinants of intertemporal valuation for social vs. private and use vs. non-use values was based on an internet questionnaire, adopting the contingent valuation

method to elicit respondent's indifference points between today's outlays and future valuation of environmental or monetary gains.

Contingent valuation is a method using stated preferences acquired via questionnaires to value goods that do not possess market prices. The method is particularly useful for environmental goods, because it captures non-use values, omitted by surrogate markets approaches, e.g. hedonic pricing. Market rates are not available for longer time horizons; therefore, the application of contingent valuation allows for creating a hypothetical market to elicit stated discount rates replacing missing market data (cf. Cropper, Aydede, Portney, 1994; Meerding et al., 2010) or use experimental designs (Frederick, 2003; Chapman, 2001; Saez, Requena, 2007). This approach, under the absence of market rates, as Heal (1997) points out, in democratic societies may bring some informative value about the trade-off between the present and the future. Sunstein and Rowell (2007) also indicate that the results obtained this way may add to policy forming.

The valuation choice tasks were described as hypothetical scenarios. In the first scenario respondents were asked to imagine that they help the government in the comparison and evaluation of two investment projects (A and B) aimed at environmental protection (environmental gains, EG): the increase in the area and quality of the mountain national parks in Poland which allow for more visits without the risk of creating any additional environmental threat. In both cases, the outlays were equal and borne immediately however only one project could be carried out. For project A the effects would appear after one year and the number of additional visitors was set at 10 individuals, while for project B the delay varied (10, 30, 90 and 150 a year) and the number of additional visits was framed as an open-ended question for respondents to fill-in the number that would make project B as good as A (a similar question format was used i.e. by Cropper et al., 1994).

In the second scenario individuals were asked to imagine that they won a lottery prize (financial gains, FG). The first option (A) was to receive 100 PLN after one year, while the second option B involved various delays (as in the case of environmental effects, these were 10, 30, 90 and 150 years) and an open-ended question format to fill-in a sum of money that would make the respondent indifferent between both options: A and B. Additionally, the description of project B contained information that if a respondent would die before receiving the gain, the money would be inherited by their children, grandchildren or other heirs).

Both scenario designs aimed at eliciting stated intertemporal indifference points or marginal rates of substitution between "immediate" effects (project or lottery A) and delayed

gains (project or lottery B). The stated delayed numbers of visits or money were used to calculate annual logarithmic rates of return as (cf. Cropper et al., 1994; Lazo et al., 1997):

$$\text{rate} = \frac{\ln\left(\frac{\text{future effects of } B}{\text{present effects of } A}\right)}{\text{delay}} \quad (1)$$

where: delay – number of years of delay minus 1 (due to a 1-year delay for project A effects); Future effects of B – delayed B's gain given as additional visitors (investment in environment) or money (lottery gain); Present effects of A – contemporary A's gains given as additional visitors (investment in the environment) or money (lottery gain).

The valuation questions were accompanied by general attitude questions as well as socio-economic characteristics (Meerding et al., 2010; Cropper et al., 1994). Attitude questions investigated the importance of the well-being of future generations, environmental protection and saving human lives. The intensity of the above attitude areas was measured using the Likert scale where “1” meant “completely unimportant” to “5” “very important”. Additionally, the frequency of charity activities was investigated, using also the 5-point Likert scale, where “1” meant “never” and “5” – “more often than once a month”. A socio-economic profile included questions about gender, age, education level, average monthly household income per capita, number of household members and the presence of juvenile family members.² These questions, along with delays were used to investigate whether the determinants of discount rates differ.

Consecutively, the elicited rates were used to illustrate how they change with a social or private dimension as well as with extending the time horizon, which equips both goods with non-use characteristics, first by comparing their values, and then by building non-linear regression models. Social vs. a private dimension was represented by environmental and lottery gains respectively. In the case of distinguishing between use and non-use values, the temporal boundary was established at 30 years, which defines a generational switching point (Foltyn-Zarychta, 2018). Therefore, the delays 10 and 30 years illustrate a self-centred domain, whereas the delays of 90- and 150-years altruistic sphere due to the fact that irrespectively of the social

² These socio-economic characteristics (except gender variable) were transformed into binary variables for the purpose of building the models. Initially, the socioeconomic characteristics with multiple states were: age (from “Up to 25” to “More than 65” with 10-year intervals), education level (“Primary school”, “Vocational school”, “High school”, “University degree”), average monthly household income per capita (from “Up to 500 PLN” to “More than 5,000 PLN” with 1,000 PLN intervals), number of household members (from “1” to “7 and more”) and presence of juvenile family members (number of children under 18: from “0” to “5 and more”).

or private domain, the benefits will go to someone else than the respondent. This is illustrated in Table 1.

Table 1. The distinction between a project's effect characteristics within private/social and use/non-use dimensions

	Private domain	Social domain
Self-centered domain/ use values	<i>Pure private goods with a direct utility effect</i> Financial gains in the short term (10- and 30-year delay)	<i>Mixed public goods with a direct utility effect</i> Environmental gains in the short term (10- and 30-year delay)
Altruistic domain/ non-use values	<i>Mixed private goods with an indirect utility effect</i> Financial gains in the long term (90- and 150-year delay)	<i>Pure public goods with an indirect utility effect</i> Environmental gains in the long term (90- and 150-year delay)

Source: own elaboration.

The division is designed to show the differences between consumer and citizen approaches on the epistemological level, as the two dimensions (private/social and use/non-use) indicate the three levels of intensity of consumer and citizen roles. *Pure private goods with a direct utility effect* under private and self-centred domains represents a pure consumer perspective, *Mixed public goods with a direct utility effect* as well as *Mixed private goods with an indirect utility effect* crossing both dimensions represent the mixture of citizen and consumer roles, whereas *Pure public goods with an indirect utility effect* remain within the citizen sphere only.

2. Data collection and sample characteristics

The research was based on an internet questionnaire accessed by Polish citizens - adult representatives of households. The invitation to take part in the survey was sent to a representative sample via emails and social portals. A stratified sampling method was used. The total number of individuals contacted was roughly from 3,500 to 5,000. The questionnaires were returned by 502 respondents out of which 470 were finally used in the analysis (the questionnaires with missing data as well as those stating extreme bids were eliminated via the Tukey's method (1977)).

The socio-economic characteristics of the study sample reflect the population of Poland reasonably well (WWW1). There were slightly more women than men (55% in the sample, while for the Polish population 52%), a slightly higher median age (sample – 38.7; Poland – 37.8), as well as an average number of household members (sample – 3.02; Poland – 2.82). Net

income higher than 2,000 PLN was declared by almost half of the respondents (slightly lower than the median net income for Poland). University degree holders are over-represented in the sample (44%), which could be the effect of the survey design (on-line questionnaire) and the method of selection of respondents (voluntary access by active internet users).³

3. Results

3.1. Time preference rates for environment and money

To test whether we can observe discrepancies between consumer and citizen intertemporal valuations, the analysis of time preference rate values was conducted in respect to their changes due to delay, social and economic profile and attitude of the respondent. The data results were analysed with STATISTICA 13 using basic statistics measures (mean, median, dispersion, and skewness) as well as statistical tests of the significance of differences in stated time preference rates between different variable states (normality of distribution with the Kolmogorov-Smirnov and W Shapiro-Wilk tests followed by nonparametric tests – due to the skewness of time preference rate distribution – ANOVA Friedman and Wilcoxon signed-rank and ANOVA Kruskal-Wallis or Mann–Whitney, for binary characteristics). Detailed results are given in Table A in the Appendix, while Table 2 presents a short summary.

Table 2. Stated time preference rates (%) for environmental gains and financial gains for all delays

	10-year delay			30-year delay			90-year delay			150-year delay		
	mean	median	SD	mean	median	SD	mean	median	SD	mean	median	SD
Environmental gains rates	9.9	7.7	13.4	5.5	3.8	5.6	2.5	2.3	2.3	1.8	1.5	1.7
Financial gains rates	24.0	25.6	17.5	11.2	11.7	6.9	4.9	5.1	2.7	3.4	3.4	2.0

Source: own elaboration.

In general, the rates decline with time and the differences are highly statistically significant for all delays, also indicating the divergence between a short and long time-frame. The discrepancies can be also observed between the domains. The rates (both mean and median) for environmental protection are approximately two times lower than for financial effects however the difference seems to diminish slightly for long-term (i.e. 9.9% vs. 24% mean rates for EP and FE respectively for a 10-year delay and 1.8% vs. 3.4% for a 150-year delay). There

³ A detailed description of characteristics is given in Table A in the Appendix.

are also some differences observed in relation to the distribution of the rates between EP and FE: for environmental effects, the rates for all delays are negatively skewed, while for the financial effects – the results have the right skewed distribution.

In the case of a respondent's socio-economic profile, the variations in discount rate due to gender, income and having juvenile family members were found statistically insignificant for all delays considered separately. The differences in time preference rate due to holding a university degree were found weakly significant only for environmental effects for a 30-year delay ($p = 0.08$). Age and household size differences were found to be significant for all domains and delays. Younger people tend to discount the future more steeply irrespectively of the domain and the delay. What should be pointed out is the fact that there are some differences between the types of the effect: while for environment both mean and median values are greater for younger people, for financial gains the differences appear only when comparing mean values, while median rates represent a similar level.

The results for household size indicate higher discount rates (mean) for larger households (more than 2 persons) for all delays and both types of gains. Median rates are in general also higher, except for a 10-year delay for environmental benefits as well as 10, 30 and 90-year delays for financial gains.

Attitude characteristics seem to matter more for financial gains than for environment. The importance of the future generation was found statistically significant for a 10 and 150-year delay for the environment and the rates in general grows with temporal distance up to 90 years. However, the rates for a 150-year delay are significantly lower – this disparity is even more apparent when considering median rates, which could indicate that the sole individual perception of the future generation temporal distance may matter for a valuation outcome. Willingness to be involved in a charity matter for all delays for environmental protection, except for the shorter one, however the values decrease inconsistently, which can be due to differences in the numbers of responses for the frequency of charity behaviour. Considering two most frequent answers (“rarely” and “a few times a year”) the rates grows with the willingness to help the others. In the case of the financial gains domain, the importance of saving people's lives seem the only variable that is not important for the variations in rate values. In the case of future generation importance, the rates in general are higher for people indicating lower importance. The rates also decline with the growing importance of environmental protection as well as willingness to be involved in charity work. It is worth to point out, that those discrepancies can be observed mainly for mean values, while median rates seem to be stable.

3.2. Socioeconomic and attitude determinants of time preference rates for citizens and consumer perspective

To analyse which socio-economic determinants and attitude characteristics of time preference rate matter for short and long-term as well as environment and money, a log-normal model (Generalized Linear and Nonlinear Models) was used for estimating the explanatory variables. The formal representation of the model is:

$$\text{rate} = g^{-1}(X\beta) + \varepsilon \quad (2)$$

where:

rate – expected value of discount rate,

$X\beta$ – linear predictor $X\beta = \beta_0 + \beta_1 X_1 + \dots + \beta_k X_k$,

g – link function $g(\text{rate}) = \ln(\text{rate}) = \ln(X\beta)$ therefore $\text{rate} = e^{X\beta}$.

The parameters estimation was based on all-effects statistics. The data on socioeconomic characteristics were coded as binary variables, while attitude variables based on the Likert scale were assumed to be continuous. The parameters' abbreviations are included in Table B in the Appendix. The models were built for short term (10 and 30-year delays) and long-term (90 and 150-year delays) separately, which made the delay variable a binary one as well as for environmental and financial gains. To find out which variable-set explains the time preference rate in the most suitable way, hierarchical models were built, for delay only (model A) and then by adding socio-economic characteristics (model B) and finally attitude variables (model C). The goodness-of-fit was analysed on the basis of a scaled Pearson Chi-square statistic as well as with the Akaike information criterion (AIC) and Bayesian information criterion (BIC), where the criterion of minimising the value of AIC and BIC statistics was used to choose the preferred model. Table 3 shows the results.

The results show that the models are reasonably well adjusted to raw data. The AIC criterion prefers models embracing delay as well as socioeconomic characteristics, while BIC opts for a delay-based model. However, the differences between the values (also scaled χ^2 statistics) do not differ substantially, indicating that the goodness-of-fit is similar among models.

Analysing the determinants of time preference rates, the delay enters all models, both long and short as well as environment and financial gains. Greater time distance lowers the time preference rate.

Table 3. Parameter estimates, standard errors and goodness-of-fit statistics for environmental gains (EG) and financial gains (FG) for short-term (use values) and long-term (non-use values) hierarchical models

Gain type	EG – short term			EG – long term			FG – short term			FG – long term		
	A	B	C	A	B	C	A	B	C	A	B	C
Model type ^a	2	3	4	5	6	7	8	9	10	11	12	13
Intercept	-2.02*** (0.08)	-2.18*** (0.09)	-2.47*** (0.39)	-3.18*** (0.12)	-3.29*** (0.13)	-2.78*** (0.29)	-1.05*** (0.05)	-1.12*** (0.05)	-1.61*** (0.22)	-2.51*** (0.07)	-2.59*** (0.07)	-2.53*** (0.18)
D	-0.03*** (0.00)	-0.03*** (0.00)	-0.03*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)	-0.04*** (0.00)	-0.04*** (0.00)	-0.04*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)
MALE		0.05 ^{NS} (0.04)	0.05 ^{NS} (0.04)		0.04 ^{NS} (0.03)	0.04 ^{NS} (0.03)		-0.06*** (0.02)	-0.06*** (0.02)		0.03 ^{NS} (0.02)	0.03 ^{NS} (0.02)
YNG		0.14*** (0.05)	0.13*** (0.05)		0.13*** (0.04)	0.13*** (0.04)		0.08*** (0.03)	0.07*** (0.03)		0.07*** (0.02)	0.07*** (0.02)
NO_UD		0.10*** (0.04)	0.10*** (0.04)		0.04 ^{NS} (0.03)	0.04 ^{NS} (0.03)		0.00 ^{NS} (0.02)	0.00 ^{NS} (0.02)		-0.03* (0.02)	-0.03* (0.02)
LOW_INC		-0.06 ^{NS} (0.04)	-0.08* (0.04)		-0.04 ^{NS} (0.03)	-0.03 ^{NS} (0.03)		-0.02 ^{NS} (0.02)	-0.03 ^{NS} (0.02)		-0.02 ^{NS} (0.02)	-0.02 ^{NS} (0.02)
S HH		-0.18*** (0.06)	-0.19*** (0.06)		-0.12*** (0.04)	-0.12*** (0.04)		-0.07*** (0.03)	-0.08*** (0.03)		-0.10*** (0.02)	-0.09*** (0.02)
N_CHILD		0.07 ^{NS} (0.05)	0.06 ^{NS} (0.05)		0.04 ^{NS} (0.03)	0.04 ^{NS} (0.03)		0.05* (0.03)	0.04* (0.03)		0.05*** (0.02)	0.05*** (0.02)
FGI			-0.02 ^{NS} (0.06)		-0.03 (0.06)	-0.01 ^{NS} (0.04)			0.04 ^{NS} (0.03)			-0.02 ^{NS} (0.03)

1	2	3	4	5	6	7	8	9	10	11	12	13
EPI			-0.02 ^{NS} (0.05)			0.03 ^{NS} (0.04)			0.00 ^{NS} (0.03)			0.05** (0.02)
LSI			0.12* (0.07)			-0.13*** (0.04)			0.07* (0.04)			-0.05* (0.03)
CHF			-0.03 ^{NS} (0.05)			-0.01 ^{NS} (0.04)			0.02 ^{NS} (0.03)			0.01 ^{NS} (0.02)
Scale	0.10 (0.00)	0.10 (0.00)	0.10 (0.00)	0.02 (0.00)	0.02 (0.00)	0.02 (0.00)	0.13 (0.00)	0.13 (0.00)	0.13 (0.00)	0.02 (0.00)	0.02 (0.00)	0.02 (0.00)
Scaled χ^2	938.0	938.0	936.0	936.0	936.0	934.0	942.0	942.0	940.0	942.0	942.0	940.0
AIC	-1611.1	-1629.9	-1620.7	-4626.7	-4644.6	-4633.2	-1121.2	-1132.9	-1126.1	-4355.9	-4379.7	-4366.6
BIC	-1596.5	-1586.3	-1557.7	-4612.2	-4601.0	-4570.3	-1106.7	-1089.3	-1063.1	-4341.3	-4336.0	-4303.8
Log likelihood	808.5	823.9	823.3	2316.4	2331.3	2329.6	563.6	575.5	576.1	2180.9	2198.8	2196.4

Model type includes 3 models, comprising of increasing sets of variables: A – delay only, B – delay and socioeconomic characteristics, C – all variables.

*** p < 0.01; ** p < 0.05; * p < 0.10, NS – not significant.

Source: own elaboration.

Considering socio-economic characteristics, age and household size explain the changes in the value of time preference rate for all the models and the direction of influence is the same in all cases. Younger people tend to discount future gains more, while small families discount less.

The differences between social and private as well as self-centred and altruistic domains can be observed for gender, education, income, and juvenile family member characteristics. Gender determines short-term financial gains only. The results suggest that females discount more self-centred monetary outcomes. Education level matters for the self-centred social domain and other-related financial gains, however the direction of impact differs while lower education level increases the discount rate for short-term environmental gains, it lowers the rate for long-term monetary outcomes. Lower income decreases the rates, but only in the case of potentially self-centred environmental outcomes. The presence of children under 18 lowers the rates for financial gains, both for self-centred as well as for other people.

In the case of attitude characteristics, only the importance of life-savings was found statistically significant for all of the models. This variable differentiates between the long and the short term. In the case of self-centred gains, growing importance increases the rates, while the altruistic domain works in the opposite direction, lowering the rates for people more concerned with saving human lives. The second attitude variable that explains changes in the rate is the importance of environmental protection, which positively correlates with the level of the discount rate for long-term financial gains.

4. Discussion and Conclusions

The rates for monetary effects are two times higher. The additional source of disparity is a sign for the skewness (median lower than mean rates accompanied by the positive value of the skewness statistics). Similar results, showing a steeper discounting of monetary outcomes in comparison with environmental gains, i.e. air quality, or social effects like health or life-saving, were observed i.e. by Cropper et al. (1994), Meerding et al. (2010), Berry et al. (2017), Chapman (2001), however, found out that whereas the discount rates decline with an increasing delay, they do not differ in respect to the type of the goods (the study compared saving lives, health improvements and financial effects).

The lower values of rates for a longer time-horizon indicate that the respondents value relatively higher the delayed effects in comparison with shorter horizons, which follows the results from other studies on stated time preference rates, indicating that people discount future

gains according to hyperbolic function instead of an exponential one (Loewenstein, Prelec, 1992; Bleichrodt et al., 2016). However, the results separating a short vs. long time horizon should be interpreted carefully, due to the fact that the decreasing pace of discounting with increasing temporal distance is observed also for a short-time alone (Hardisty, Weber, 2009), therefore it could reflect more the hyperbolic shape of the function than the differences in treatment between the use and non-use domain. Nevertheless, it allows for more preferential treatment of the wellbeing of other people (distant in time) than standard, exponential discounting models.

Table 4. The summary of differences in statistically significant explanatory variables and the direction of their influence

	Private domain	Social domain
Self-centered domain/use values	D (-) MALE (-) YNG (+) S_HH (-) N_CHILD (+) LSI (+)	D (-) YNG (+) No_UD (+) LOW_INC (-) S_HH (-) LSI (+)
Altruistic domain/non-use values	D (-) YNG (+) No_UD (-) S_HH (-) N_CHILD (+) EPI (+) LSI (-)	D (-) YNG (+) S_HH (-) LSI (-)

Source: own elaboration.

Financial gains describing the private domain differ from environmental also with respect to socio-economic characteristics. While age and family size impacts consecutively across all dimensions, the presence of young children affects monetary outcomes only. Education level impacts use values in social domains and non-use in the private area; however the direction of the influence differs. Eventually, gender as well as income appears specifically within one area: the former in case of self-centred private effects, increasing the rate for financial gains for female respondents, while the latter is significant for the use-value social domain and indicate that lower-income households discount short-term environmental effects less. Other researches confirm partially those results; however, it needs to be pointed out that the amount of research tackling this issue is low. Meerding et al. reports i.e. higher rates for better educated and lower for lower income respondents, both for money and health for the 5-year horizon, which supports the results above. Luckert and Adamowicz (1993) investigating long-term environmental impacts also found a positive correlation between the level of education and the value of the

discount rate as well as lower rates for lower income. Cropper et al. indicate that in the case of life-saving programs for horizons over 25 years the declared rates were higher for persons with young children, which could partially be in line with the higher rates for larger households, however this conclusion should be treated carefully due to the fact that this variable was found out to be statistically insignificant. Cropper et al. (1994) and Luckert and Adamowicz's (1993) results indicate that male individuals discount less, while this research shows the opposite.

Finally, moving to attitude variables, two of them seem to distinguish between the domains. The perception of environment importance matters, but only in the case of long-term financial effects – non-use and self-centred effects are discounted with higher rates with the increase in the importance of the environment, which may be explained by assuming that the environment may be perceived here as a substitute good – more environmentally oriented people will value future monetary gains less. Non-use values (appearing beyond the life-time horizon of the respondent) tend to be discounted with lower rates for people declaring higher importance for saving human lives for both, environmental and financial gains. Therefore, it affects positively the valuation of non-use effects (more preferential treatment via lower rates). On the other hand, this variable is also significant for the short term, both for financial as well as environmental effects, however in this case it increases the discount rate with importance placed on life saving. This variation in the LSI impact between the short and long-term may indicate that personal gains (use values) are less important for people more concerned with issues vital for human survival. As Moser et al. (2013) points out, discounting may be related to an emotional relationship: The more emotionally involved participants feel about the future the less they discount. This result also seems to support the paper's claim that it is justified to separate between consumer and citizen valuations.

Concluding, the empirical hypothesis tested in the paper can be quite firmly confirmed if disparities in discount rate values are taken into consideration. The results indicate that intertemporal allocation preferences differ in respect to both dimensions: environmental and monetary gains as well as use (short) and non-use values (long-time horizon). The time preference rate is significantly lower for environmental gains, both for the short as well as the long horizon, in comparison with financial effects. The differences in values are also observed when the short- and long-term horizon is compared, with lower rates for the latter. However, the analysis of differences in the set of explanatory variables based on regression models, do not confirm the hypothesis. We may conclude that despite the fact that socioeconomic characteristics, attitude and delay variables differ between the four types of goods (pure private, mixed private and public and pure public), which for this study might support the claim that

these should be discounted separately, the generalization should be done carefully. The scarcity of other research as well as disparities found between these results and other studies suggest the need for further investigation.

In general, the results indicate that the epistemological argument for distinguishing between the roles of consumers and citizens characterized by the two dimensions: social/private and use-/non-use may be considered to be justified reasonably well by the results. The empirical layer, investigating the disparities between consumer and citizen spheres, proves that the discrepancies exist, which makes the results relevant for public policy shaping i.e. climate change and other long-term environmental protection issues.

Appendix

Table A. Stated time preference rates (%) for environmental gains (EG) and financial gains (FG) for delays, attitude and socio-economic characteristics

Variables	Environmental gains										Financial gains									
	Delay	10		30		90		150		Delay	10		30		90		150			
	Share	M	SD	M	SD	M	SD	M	SD	Share	M	SD	M	SD	M	SD	M	SD		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
General	100	9.9	13.4	5.5	5.6	2.5	2.3	1.8	1.7	100	24.0	17.5	11.2	6.9	4.9	2.7	3.4	2.0		
Future Generations Importance		**a		NS		NS		**			*		*		**		**			
1	1	0.0	0.0	4.4	4.7	2.2	2.1	0.0	0.0	1	17.1	14.8	7.8	6.8	3.2	2.7	3.5	3.0		
2	2	2.2	7.7	3.9	5.6	2.1	2.8	1.5	1.9	2	25.0	14.0	12.4	4.4	5.9	1.9	4.3	1.3		
3	62	10.1	12.4	5.5	5.0	2.4	2.1	1.7	1.5	62	24.2	17.2	11.4	6.9	4.9	2.7	3.5	1.9		
4	28	11.2	15.7	6.2	6.7	2.8	2.7	2.0	1.9	28	25.5	18.2	11.7	6.8	5.0	2.7	3.5	1.9		
5	8	6.5	12.0	3.9	5.3	1.9	2.3	1.3	1.8	8	17.0	17.6	8.2	7.3	3.4	3.4	2.6	2.7		
Environmental Protection Importance		NS		NS		NS		NS			*		**		***		**			
1	0	0.0	—	0.0	—	0.0	—	0.0	—	0	25.6		15.9		7.8		6.2			
2	6	12.0	15.9	6.8	6.5	3.0	2.6	2.1	2.0	6	27.2	16.5	12.8	6.2	5.6	2.7	3.8	1.9		
3	26	11.1	13.3	6.3	5.7	2.8	2.5	2.0	1.7	26	26.1	16.9	12.4	6.5	5.4	2.6	3.8	2.0		
4	52	9.8	13.3	5.2	5.4	2.4	2.2	1.7	1.7	52	23.7	18.2	10.8	7.1	4.7	2.7	3.4	1.9		
5	16	7.7	12.8	4.8	5.4	2.1	2.3	1.4	1.6	15	20.3	16.2	9.9	6.8	4.1	2.8	2.9	1.9		
Life Saving Importance		NS		NS		NS		NS			NS		NS		NS		NS			
1	0	—	—	—	—	—	—	—	—	0										
2	1	13.7	14.5	6.6	5.7	3.2	2.4	2.6	1.0	1	19.9	9.3	9.1	3.9	3.4	1.6	2.4	1.2		
3	8	13.5	14.5	6.9	5.0	2.8	2.0	1.8	1.4	8	21.3	16.7	10.3	6.5	4.7	2.7	3.6	2.1		
4	38	9.2	12.6	5.2	5.3	2.4	2.4	1.7	1.7	38	22.4	16.3	10.6	6.5	4.7	2.6	3.2	1.9		
5	53	9.8	13.7	5.5	5.8	2.5	2.3	1.8	1.8	53	25.6	18.4	11.9	7.2	5.0	2.8	3.6	2.0		
Charity Frequency		NS		**		*		*			**		**		*		*			
1	4	12.9	13.3	7.2	5.6	2.6	2.0	1.8	1.6	4	31.2	11.7	14.4	4.4	5.8	1.8	4.1	1.4		
2	30	7.8	12.7	4.4	5.3	2.1	2.3	1.5	1.6	30	21.4	15.3	10.1	6.6	4.3	2.6	3.1	1.9		
3	51	10.9	14.0	6.0	5.6	2.7	2.4	1.9	1.7	50	25.6	19.3	11.8	7.4	5.1	2.9	3.6	2.1		
4	10	10.7	11.3	6.0	5.5	2.7	2.4	2.0	1.8	10	20.7	13.6	10.6	5.3	5.0	2.4	3.6	1.8		
5	6	8.6	13.1	5.0	6.1	2.2	2.3	1.8	2.1	6	24.4	19.6	10.9	7.3	4.5	2.8	3.1	1.8		

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Gender		NS		NS		NS		NS			NS		NS		NS		NS	
Female	55	9.5	13.1	5.3	5.3	2.3	2.1	1.7	1.6	55	25.3	18.5	11.5	7.1	4.8	2.7	3.3	2.0
Male	45	10.3	13.7	5.8	5.9	2.7	2.6	1.8	1.8	45	22.5	16.1	10.9	6.7	5.0	2.8	3.6	2.0
Age		**		**		**		***			*		**		***		**	
≤45	64	10.9	14.1	6.0	5.8	2.7	2.5	1.9	1.8	64	25.1	17.5	11.8	6.7	5.1	2.7	3.6	1.9
>45	36	8.1	11.7	4.7	4.9	2.1	2.0	1.5	1.5	36	22.1	17.5	10.2	7.2	4.4	2.8	3.2	2.0
University degree		NS		*		NS		NS			NS		NS		NS		NS	
no	56	10.8	14.8	5.9	6.0	2.6	2.4	1.8	1.7	56	24.1	17.6	11.0	6.8	4.8	2.7	3.4	2.0
yes	45	8.8	11.3	4.9	5.0	2.3	2.3	1.7	1.7	44	23.9	17.4	11.5	7.1	5.0	2.8	3.5	2.0
Income per capita		NS		NS		NS		NS			NS		NS		NS		NS	
≤2000 PLN	52	9.6	13.7	5.4	5.7	2.4	2.4	1.7	1.7	24	23.8	18.4	11.0	7.2	4.8	2.8	3.4	2.0
>2000 PLN	48	10.2	13.0	5.7	5.4	2.5	2.3	1.8	1.7	76	24.2	16.6	11.5	6.7	4.9	2.7	3.5	1.9
Household size		*		**		**		**			*		**		**		**	
≤2 persons	32	7.8	11.0	4.6	5.1	2.1	2.2	1.5	1.6	32	22.1	17.1	10.3	7.0	4.4	2.9	3.1	2.1
>2 persons	68	10.9	14.2	5.9	5.8	2.6	2.4	1.9	1.7	68	24.9	17.7	11.7	6.8	5.1	2.6	3.6	1.9
Juvenile family members		NS		NS		NS		NS			NS		NS		NS		NS	
no	68	9.8	12.7	5.5	5.6	2.4	2.4	1.7	1.7	68	24.2	17.3	11.4	7.0	4.9	2.8	3.5	2.0
yes	32	10.1	14.6	5.5	5.5	2.6	2.3	1.8	1.6	32	23.5	18.1	10.9	6.7	4.8	2.7	3.4	1.9

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$, NS – not significant.

Source: own elaboration.

Table B. The list of variables and abbreviations used in the model

Variable	Abbreviation in the models
Discrete variable	
Delay of investment effects (10, 30, 90 or 150 years)	D
Binary variables	
Gender (for male respondents)	MALE
Age (lower than 45 years old)	YNG
Education (holding no university degree)	NO_UD
Average monthly household income per capita (lower than 2,000 – low income household)	LOW_INC
Family size (smaller than 3 members – small household)	S_HH
Absence of children under 18 years old (no children under 18)	N_CHILD
Continuous variables (Likert scale 1–5)	
Importance of future generations	FGI
Importance of environmental protection	EPI
Importance of saving human lives	LSI
Charity behaviour frequency	CHF

Source: own elaboration.

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