ECONOMIC ANALYSIS OF INDIVIDUAL BEHAVIOR AND GOVERNANCE FOR STABILITY AND SUSTAINABILITY

by

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ABSTRACT

With the growing threats of abrupt and irreversible change in Earth's atmosphere, stability and sustainability become two essential elements for the existence and continuation of human life on the planet Earth. Simultaneously, humans are pursuing happiness as the ultimate goal of their lives, leading them to focus on the short term benefits without considering the long term harm to the Earth. Thus, the way individuals pursue happiness and behave in this situation should be explored to understand the relationship between happiness and the concern for the future, which enables us to suggest an appropriate mechanism or institution for considering future generations. To this purpose, the thesis applies a questionnaire survey and a laboratory experiment and collects primary and secondary data to examine determinants of subjective happiness at the individual level, study the individual behavior in intergenerational sustainability dilemma situations and identify the factors affecting the stability of public health allocations.

The first study in this thesis examines the relationships among happiness, the concern for future generations i.e., generativity and social preferences, along with sociodemographic factors, within a single analytical framework. We hypothesize that generativity and social preferences are determinants of happiness, posing a research question "Are people happier by being prosocial and/or generative for sustainability?" We conduct a survey experiment, collecting data from five subjective happiness scales, generativity, social value orientation and sociodemographic variables in one urban area (Dhaka) and two rural areas (Bogra and Gaibandha) in Bangladesh. We empirically characterize determinants of subjective happiness with the data, focusing on generativity and social value orientation, controlling for sociodemographic factors. The statistical analysis consistently shows a positive association between

subjective happiness and generativity, irrespective of the type of happiness scale, while social value orientation does not exhibit any significance. Rural residents have lower peer relative happiness than urban residents, and household income has a positive relationship with general subjective happiness, leading each of these factors to be significant in overall subjective happiness. In summary, generativity, income, and residence area are main determinants of happiness, implying that further urbanization, which is expected to occur in the future, will positively affect people's happiness if it can increase generativity. These results also suggest a possibility that people are happier by being more generative for sustainability, and some new institutional frameworks such as future design shall be recommended to enhance generativity.

In the second study, we examine the individual behaviors in the intergenerational sustainability dilemma (ISD), which is a situation of whether or not a person sacrifices her benefits for future sustainability. A one-person ISD game (ISDG) is instituted with a strategy method where individual's queue is organized as a generational sequence to examine individual behaviors. In ISDG, each individual chooses an unsustainable (or sustainable) option with her payoff of X ($X - D$) and an irreversible cost of D (zero cost) to future generations in 36 situations. Future ahead and back (FAB) mechanism is suggested as a resolution for ISD by taking the perspective of future generation whereby each individual is first asked to take the next generation's standpoint and request what she wants the current generation to choose, and, second, to make the actual decision from the original position. Results show that individuals choose the unsustainable option as previous generations do so or $\frac{X}{D}$ is low (i.e., sustainability is endangered). However, FAB prevents individuals from choosing the unsustainable option in such endangered situations. Overall, the results suggest that some new institutions, such as FAB mechanisms, which induce people to take future generations' perspective, may be necessary to avoid intergenerational unsustainability, especially when intergenerational sustainability is highly endangered.

In the third study, we empirically explore the effect of the emergence of health disasters on public health allocation instability. The thesis uses the punctuation equilibrium theory framework to define public health allocation instability. The punctuation represents instability, which identified to be an increase with more than 35 % i.e., positive punctuation or a decrease with more than 25 % i.e., negative

punctuation in the yearly change of public health allocations in a country. Public health allocation instability can be attributed to the emergence of new events, such as health pandemics, covered by media, leading to major changes in policy or budget setting. Thus, we hypothesize that disasters are the main determinants of public health allocation instability. Data of 191 countries from 1995 to 2015 are utilized to test this hypothesis. Our statistical analyses show that countries with weak governance tend to face punctuation in the public health allocations compared to those with strong governance. The least developed counties have higher probability of facing negative punctuation than developed countries. Our results do not support our hypothesis that disasters influence public health allocation instability. Instead, governance and economic development are the important determinants of public health allocation instability.

Key Words: Happiness; generativity; intergenerational sustainability dilemma; individual behavior; public health allocations; governance.

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Chapter 1

Introduction

Several intergenerational welfare problems have become pressing issues due to the changes in political and economic systems for the last few decades. These problems impose an unprecedented challenge for humans to maintain the wellbeing of the current generation and the sustainability for future generations. This challenge can be exemplified by the long term financial instability represented by the accumulation of public debt in countries all over the world in addition to climate changes represented by global warming and the loss of biodiversity as a result of human interference (Greenhalgh, 2005; Hansen and İmrohoroğlu, 2016; Steffen et al., 2018; Bamber et al., 2019). These growing threats of irreversible climate and financial changes must be faced through economic actions on individual, organizational, societal levels. Thus, it is important to understand the factors that affect individuals' wellbeing and their behaviors towards intergenerational welfare problems to suggest the proper mechanism to enhance and maintain stability and sustainability.

The majority of countries in the world adopt democracy and capitalism as social and economic institutions, which provide individuals with freedom of choices for various products and services as well as freedom of speech to pursue further economic growth and prosperity (Friedman, 2002; Schumpeter, 2008; Roskin et al., 2017). However, it is reported that capitalism and democracy bring about consumerism and self-maximization behaviors to be the main sources of wellbeing (i.e., happiness), leading to the emergence of various intragenerational and intergenerational problems for sustainability in many countries (Headey et al., 2007; Kolstad, 2010; Gilovich et al., 2015). In other words, capitalism and democracy are claimed to be institutions that cannot ensure sustainability along with happiness, and some researchers argue that existent social institutions or regimes, such as communism, may not be able to do so (Chen, 1993; Portney and Stavins, 2000; Hanley et al., 2006; Schumpeter, 2008; Benson and Craig, 2014). Sustainability and wellbeing can be ensured by solving intragenerational and intergenerational problems (Goodland, 1995; Glotzbach and Baumgartner, 2012). Therefore, we need to find a way to balance the happiness of the current generation and sustainability for future generations.

This thesis can be considered an attempt to find that way by studying happiness and its relationship with sustainability for future generations and test perspective-taking as a mechanism to resolve intergenerational sustainability dilemma (ISD). Besides, the thesis empirically explores the factors influence health allocations instability that affects individual happiness.

Previous research has analyzed several potential determinants of happiness in the last few decades. The literature finds that a prosocial behavior (i.e., charity or buying some gifts for friends) has a positive association with happiness, showing that such prosocial acts and individual happiness demonstrate a positive feedback loop (Dunn et al., 2008; Konow and Earley, 2008; Aknin et al., 2012; Dunn et al., 2014; Nelson et al., 2016). Other researchers have focused on examining the association between sociodemographic factors and happiness, finding that earning a high income or living in an urban area have strong positive relationships with happiness (Easterlin, 2003; Biswas-Diener et al., 2004; Kahneman et al., 2006; Requena, 2015; Asadullah et al., 2018; Kim, 2018). Simultaneously, the psychological factors affecting happiness have been explored by several psychologists, indicating that generativity have a correlation with happiness (Hofer et al., 2007; Huta and Zuroff, 2008; Hofer et al., 2014, 2016; Au et al., 2019). These studies show that prosocial actions, income, residential area and generativity are potential determinants of happiness.

Many scholars have studied intergenerational sustainability issues, suggesting some mechanisms as a resolution. The ISD represents a typical situation where the current generation chooses to maximize (sacrifice) its benefits without (for) considering future generations, compromising (maintaining) IS where communications among generations cannot be made (Kamijo et al., 2017; Shahrier et al., 2017c). Kamijo et al. (2017) design and implement an ISD game (ISDG) in the laboratory with a group of three individuals, suggesting that the introduction of an individual who is asked to play the role of deputy for future generations, called an imaginary future person, enhances IS. Shahrier et al. (2017c,a) conduct an ISDG field experiment in urban and rural areas of Bangladesh, indicating that the introduction of a mechanism that induces subjects to take and understand the next generation's perspective before making their decision improves IS. Timilsina et al. (2019b) apply an ISDG field experiment in Nepal, suggesting that asking individual for reason and advice for their decision i.e., intergenerational accountability mechanism, reduces unsustainable group behaviors. These studies focused on the group behavior in ISDG, finding that introducing some mechanisms enhance the group's behavior toward maintaining intergenerational sustainability.

Health and wellbeing are mainstream policy issues over the years and the concern of a widening range of agencies. The provision of universal health service is the shortest way to enhance individuals' wellbeing in a society. However, this requires enormous support from the government by allocating sufficient budget for the health sector and these allocations vary vastly due to several factors. Many scholars have studied the variations of governmental budgetary allocations among different sectors. Previous research finds that institutional constraints are the reason for the fluctuations in governmental budgetary allocations (Breunig, 2006; Ryu, 2009). Other scholars have examined determinants of health allocation instability, finding that the governmental ideology and debts are the leading cause for such instability (Bellido et al., 2018; Behera and Dash, 2019; Bettin and Sacchi, 2020). Overall, previous research has shown that fluctuations in public budgetary allocations, especially health allocations, are influenced by political and economic factors.

None of the past studies have explored determinants of individual subjective happiness in relation to the concern for future generations (i.e., generativity), individuals' behavior in ISDG and the factors affecting public health allocation's stability. Therefore, in this research, first we analyze determinants of individual happiness by controlling for social value orientation, generativity and sociodemographic factors. In the second stage, we analyze individuals' behaviors in ISDG and test the effectiveness of "future ahead and back mechanism" to maintain intergenerational sustainability in different ISD situations. Finally, we systematically explore the factors that affect public health allocations instability using panel data.

The later parts of this thesis organized as follows: chapter 2 entitled "Happiness, generativity and social preferences in a developing country: A possibility of future design" presents the details of the survey conducted in Bangladesh and the main results. The study of individual behavior towards intergenerational sustainability dilemma, which presents the laboratory experiment and the main findings related to this experiment, is presented in chapter 3 entitled "Does perspective-taking promote intergenerational sustainability?" Chapter 4 examines the factors that affect the stability of public health allocations, which is reflected in the individual health and the overall wellbeing of society.

Chapter 2

Happiness, generativity and social preferences in a developing country: A possibility of future design

2.1 Introduction

The greatest philosophers and scholars in history, such as Aristotle and Bentham, claim that happiness is an ultimate goal of human life (Lyubomirsky, 2001; Sato et al., 2015). In contemporary societies, happiness is interpreted as an outcome of a "good life," which is established to be driven by social status and/or some sociodemographic factors, and thus people are assumed to behave for pursuing happiness (Diener et al., 1985; Frey, 2008; Knight et al., 2009; Asadullah and Chaudhury, 2012). On the other hand, generativity and prosociality in human preferences and behaviors are claimed to be essential for the betterment and sustainability of societies (McAdams and de St. Aubin, 1992; Timilsina et al., 2019a). This is because they are conceptualized as the concern and commitment for people in current and future generations, inducing a higher level of cooperation for various social and sustainability problems. Happiness and sustainability are fundamental foundations for human life; however, it is becoming a big challenge for contemporary societies to maintain sustainability exemplified by recent problems of "global climate change" and "government debts," while people are pursuing happiness.

Sustainability can be ensured by solving not only intragenerational, but also intergenerational problems (Goodland, 1995; Glotzbach and Baumgartner, 2012). An intragenerational problem is a problem that arises among people in the same generation such as utilization of common pool resources and provision of public goods. Some literature demonstrates that prosocial people are likely to contribute more to the solution of such intragenerational problems (Timilsina et al., 2017). On the other hand, an intergenerational problem is a problem that arises among people over different generations including future generations, such as climate change and government debt. Generativity (concern and commitment for future generations) or generative actions are claimed to be essential for the solutions of intergenerational problems through transferring skills, social capital as well as environmental and natural resources to future generations (Milfont and Sibley, 2011; Alisat et al., 2014). Thus, prosociality and generativity can be considered crucial factors for sustainability of societies.

A main concern is how to develop our societies in a sustainable way by solving intragenerational and intergenerational problems as well as how to improve or at least maintain happiness at the same time. To address these issues, we hypothesize that generativity and social preferences of prosociality are determinants of happiness, posing a research question “Are people happier by being prosocial and/or generative for sustainability?” We conduct a survey experiment, collecting data from five subjective happiness scales, generativity, social value orientation and sociodemographic variables in one urban area (Dhaka) and two rural areas (Bogra and Gaibandha) in Bangladesh. With the data, we empirically characterize determinants of subjective happiness with a focus on generativity and social value orientation, controlling for sociodemographic factors. Answering the research question enables us to suggest some institutions that ensure sustainability by inducing people to be prosocial and generative without compromising happiness. Some researchers advocate new institutions to connect people in the current generation with one another as well as with future generations to solve intragenerational and intergenerational problems, suggesting a new field of research, “future design” (Nakagawa et al., 2017; Hara et al., 2019; Saijo, 2020). If our question is answered “yes,” the future design can possibly be considered and recommended as a promising institution to be able to enhance generativity and prosociality for not only sustainability, but also happiness.

Social status and/or sociodemographic factors have been studied as the possible determinants of a “good life,” leading to an increase in individual happiness. The previous literature has focused on examining the association of particular economic factors and urbanization with happiness. Income is generally reported to have a positive relationship with happiness, while age, gender, education and religion show mixed outcomes (Easterlin, 2003; Biswas-Diener et al., 2004; Kahneman et al., 2006; Asadullah et al., 2018). Requena (2015); Kim (2018) compare people’s happiness between rural and urban areas in both developed and developing countries. They illustrate that rural residents have less happiness than urban residents in developing countries, while the opposite is true in developed countries. They argue that the result may be due to living standards and the availability of public goods, depending on the stages of economic development.

Several studies in psychology have examined the correlation between generativity and happiness. McAdams and de St. Aubin (1992); de St. Aubin and McAdams (1995) and Keyes and Ryff (1998) collect data using a generativity behavioral checklist (GBC) from student and adult subject pools in the USA, establishing a positive correlation. Stewart et al. (2001) study a temporal change in happiness in middle-aged women in the USA, finding that happiness does not necessarily decline in age and has a positive association with generativity. Hofer et al. (2007); Huta and Zuroff (2008); Hofer et al. (2014, 2016) and Au et al. (2019) address the possible mediators between happiness, life satisfaction and generativity for student and adult subjects. They find that some mediators, such as symbolic immortality and altruism, explain the relationships among the factors. Other studies has focused on the relationship between sustainability and generativity. Jia et al. (2015, 2016) study how generativity is related to sustainable attitudes towards the environment (i.e., environmentalism) and find that people with high generativity tend to be more sustainable for environment. Matsuba et al. (2012) also find that the engagement in generative activities leads people to take sustainable and environmental actions.

Previous studies have established that there is a positive association between happiness and generativity using two-variable correlation analysis and prosocial acts tend to increase happiness. However, it is claimed that prosocial acts are at most spontaneous or temporal, and it is important to consider individual social preferences along with sociodemographic factors because the preference is established to be stable or not to change in the long run (Varian, 1992; Aknin et al., 2012; Carlsson et al., 2014). Moreover, little is known about the relationships among happiness, generativity and social preferences, along with sociodemographic factors, within a single analytical framework, despite the importance of the three factors in understanding the betterment and sustainability of societies in the future.

Based on the past studies, our survey experiment employs subjective happiness scale (SHS), generative behavior checklist (GBC) and social value orientation (SVO) for subjects' happiness, generativity and social preferences of prosociality, respectively (McAdams and de St. Aubin, 1992; Van Lange et al., 1997; McAdams et al., 1998; Lyubomirsky and Lepper, 1999; Van Lange et al., 2007). We use the SHS as it is known to be a reliable and widely used scale for measuring individual happiness (Lyubomirsky and Lepper, 1999; Tuchtenhagen et al., 2015; Sato et al., 2019). The GBC is the best measurement in the field research because of its simplicity; subjects simply need to answer whether they have taken specific generative activities and the frequencies in the list for the last two months (McAdams and de St. Aubin, 1992; McAdams et al., 1998). A triple dominance method is chosen for SVO because it is demonstrated that Bangladeshi subjects can easily understand and it is effective for the purpose of comparison (Van Lange et al., 1997, 2007; Shahrier et al., 2016).

2.2 Methods and materials

2.2.1 Study areas

We conducted a questionnaire survey and experiment in three districts of Bangladesh: Dhaka, Bogra and Gaibandha (Figure 2.1). We consider them to be one urban area, Dhaka, and two rural areas, Bogra and Gaibandha. We choose the regions because they possess the same culture, language and religious variation, except sociodemographic factors and economic development, where Bangladesh is culturally and ethnically a homogeneous country. Dhaka is the capital city, representing an urban society, and is located between $23°55'$ and $24°81'$ north latitude and between $90°18'$ and $90°57'$ east longitude Dewan and Corner (2014). The population, population density and total area are 14.51 million, 10,484 km^{-2} and 1371 km^2, respectively, which makes Dhaka the most populated city in the world.

Figure 2.1: Map of Bangladesh.

The rural areas consist of two districts: (i) Bogra and (ii) Gaibandha. Bogra consists of two unions of the Shajahanpur subdistrict in the northern districts, Amrool and Chopinagar (Figure 2.1). The location of the Shajhanpur subdistrict is between 24°41′ and 24°50′ north latitude and between 89°16′ and 89°29′ east longitude. Shajhanpur's land area is 54,783 acres; Amrool and Chopinagar's land area is 6106 acres and 4048 acres, respectively Bangladesh Bureau of Statistics (2011). The population densities in Amrool and Chopinagar are 951 km^{-2} and 1357 km^{-2}, respectively, whereas the country average is 1218 km^{-2} Bangladesh Bureau of Statistics (2011). The villages in these two unions are agrarian societies, while agro-based and small-scale businesses are found in very limited areas.

Gaibandha comprises three unions of the Palashbari subdistrict: Harinathpur, Hossainpur and Monoharpur. The location of Palashbari is between 25°11′ and 25°19′ north latitude and between 89°16′ and 89°32′ east longitude. The land area, population density and total population in the Palashbari are 45,774 acres, 1321 km^{-2} and 244,792, respectively Bangladesh Bureau of Statistics (2011). The villages in the unions are also agrarian societies, and they are considered the least developed in Bangladesh. All the dwellers engage in farming either as subsistence farmers or as cash-crop farmers. In what follows, we refer to these study areas as Bogra and Gaibandha, interchangeably mentioning them as rural areas.

We collected 105 subjects in Dhaka using an individual survey based on our randomization on the proportion of each occupation in the population Bangladesh Bureau of Statistics (2015). The number of subjects needed in each occupation was determined, and we selected a certain number of organizations for each occupation. Then, we contacted these organizations, and we randomly invited subjects from these organizations based on their responses. The response rates for organizations and for subjects were 50% and 60%, respectively. We collected 142 and 150 subjects in two rural areas of Bogra and Gaibandha, respectively, using an individual survey with the following random sampling procedures. First, we obtained a list of the households that reside in Bogra and Gaibandha from local city offices, and we randomly chose households that approximate the representatives for each area. Second, we sent a letter to invite one member (who earns an income) from each household to participate in our survey and experiment, and the response rate was 75%. As of the measurement for the main variables in our analysis, the subjective happiness scale (SHS), generative behavioral checklist (GBC) and social value orientation (SVO) were employed to represent subjects' happiness, generativity and social preferences, respectively McAdams and de St. Aubin (1992); Van Lange et al. (1997); McAdams et al. (1998); Lyubomirsky and Lepper (1999); Van Lange et al. (2007) (see the supplementary material of our questionnaire).

2.2.2 Experimental procedure

We use the subjective happiness scale with a four-item measurement developed by Lyubomirsky and Lepper Lyubomirsky and Lepper (1999), where each item is rated on a 7-point Likert scale. The first question in the scale reports individual absolute self-rated happiness (AH) by stating, "In general, I consider myself," and its anchors are "not a very happy person" and "a very happy person." The second item reports individual relative happiness as compared to that of peers by stating, "Compared to my peers, I consider myself," and its anchors are "less happy" or "more happy"; it is called peer relative happiness (PRH). The third and fourth items correspond to a general description of a happy and/or unhappy person, where subjects make a choice to describe themselves best. In the items—"Some people are generally very happy. They enjoy life no matter what is going on, getting the most of everything. How much does this sentence describe you?" and "Some people are generally not very happy. Although they are not depressed, they never seem as happy as they might be. How much does this sentence describe you?"—the anchors are "not at all" and "a great deal," which are called general subjective happiness and unhappiness (i.e., GSH and GSU), respectively. To calculate the overall subjective happiness (OSH), the average of the four items is calculated, while the fourth item is reversely coded.

The generative behavior checklist (GBC) developed by de St Aubin and McAdams McAdams and de St. Aubin (1992) is employed to measure the frequency of people's generative behaviors in the last two months. This measure contains a list of 50 activities, of which only 40 activities are considered indicators of "generativity." "Taught somebody a skill," "Gave money to a charity," "Made a decision that influenced many people" and "Served as a role model for a young person" are some examples of the generative activities. Subjects need to choose one of the three options for each activity. The "zero," "one" or "two" scores indicate that subjects have not participated in each generative activity, participated in it once or participated in it more than once over the last two months, respectively. The generativity score for each subject is calculated as the sum of the scores for all 40 items.

Social value orientation (SVO) developed by Van Lange et al. Van Lange et al. (1997) is employed to identify the social preference of each subject. This game consists of nine items, each of which contains three choices. Subjects are asked to make one choice for each item, dividing an amount of money between himself/herself and a stranger; for example, (A) you get 500, and the other gets 100; (B) you get 500, and the other gets 500; and (C) you get 560, and the other gets 330. Option (A) represents the competitive person, as it maximizes the gap between self point and the other's point $(500 - 100 = 400)$.

Option (B) represents the prosocial person, as it maximizes the joint benefit $(500 + 500 = 1000)$, while option (C) is the individualistic person, as it maximizes its own benefits without considering those of others Van Lange et al. (2007). Four types of individual SVOs are identified by this game, i.e., individualistic, competitive, prosocial and unidentified, based on their choices in the game. When the subject makes a consistent choice in six items for one orientation (i.e., individualistic, competitive or prosocial), then he/she is considered to be that orientation, and otherwise, he/she is considered to be "unidentified." We drop all the "unidentified" subjects from our data because we can not specify their social preference. We randomly match two subjects as a pair to compute their final payoff based on their performances in the game. Subjects are paid on average 100 BDT for the SVO, while a fixed participation fee of 150 BDT is paid to all subjects, and the total payment on average is 250 BDT per subject.

2.2.3 Empirical method

Our main goal of this paper is to study the effect of sustainability determinants (i.e., generativity and social preferences) on happiness while controlling for other factors. To this end, parametric and nonparametric statistical analyses are employed by utilizing the data of SHS, GBC, SVO and sociodemographic factors collected in a questionnaire survey and experiment. Nonparametric Mann–Whitney test is applied to check the difference in the distributions of subjective happiness (SH) between the urban and rural areas or between the prosocial and proself orientations in SVO, while Pearson's correlation is applied to discover the nature of the relationship between SH and generativity and the key sociodemographic factors. To examine the effect of generativity and social preferences on happiness holding other factors fixed, we also employ regression analyses to quantitatively identify determinants of SHS. Poisson regression is applied for the four components of SHS, as the scales are count variables (i.e., absolute self-rated happiness (AH), peer relative happiness (PRH), general subjective happiness (GSH) and general subjective unhappiness (GSU)), while we apply ordinary least squares (OLS) for the aggregate SHS (i.e., overall subjective happiness), as it is a continuous variable. The following equation is estimated for Poisson regression and OLS ($k \in \{\text{AH}, \text{PRH}, \text{GSH}, \text{GSU}, \text{OSH}\}$):

$$Y^k = \beta_0^k + \beta_1^k X + \beta_2^k S + \beta_3^k Z + \epsilon^k, \tag{2.1}$$

where Y^k is the explained variable (AH, PRH, GSH, GSU and OSH), X is the generativity score of subjects, S is a dummy variable representing SVO that takes unity for individualistic and competitive subjects (i.e., proself) and 0, otherwise, Z is a vector of sociodemographic variables that may affect SH, and ϵ^k is the error term (see Table 2.1 for the definitions of every variable used in the statistical analysis). The parameters β_is for $i = 0, 1, 2$ are the coefficients of the intercept, X and S, and β_3 is a vector of the coefficients for independent variables Z related to the sociodemographic factors.

With the regression analysis of Equation (2.1), we intend to examine a conceptual framework for the relationships among subjective happiness (SH), generativity and SVO, along with sociodemographic factors in Figure 2.2. In this framework, a coefficient of each key variable, $\beta_i, i = 0, 1, 2$, is considered to represent the marginal effect of that variable on SH after the effects of the other variables are netted out Wooldridge (2019, 2010). For example, β_1 is considered to represent the effect of generativity on SH after the effects of SVO and the sociodemographic factors have been netted out, while some possible mediators may play roles in characterizing subjective happiness through several independent variables. In this research, our focus is on estimating β_1, β_2 and β_3 in Figure 2.2. The interpretation of these coefficients in Poisson regression is derived as follows Wooldridge (2019): the marginal effect of a continuous independent variable such as generativity should be calculated using the formula of $100 \times \beta_j$ to be a percentage change in Y when the continuous variable increases by one unit. In the case of a dummy independent variable such as SVO (proself $= 1$, and otherwise, 0), it is calculated by $\exp(\beta_j) - 1$ being interpreted as a percentage change in Y when the dummy variable increases from 0 to 1.

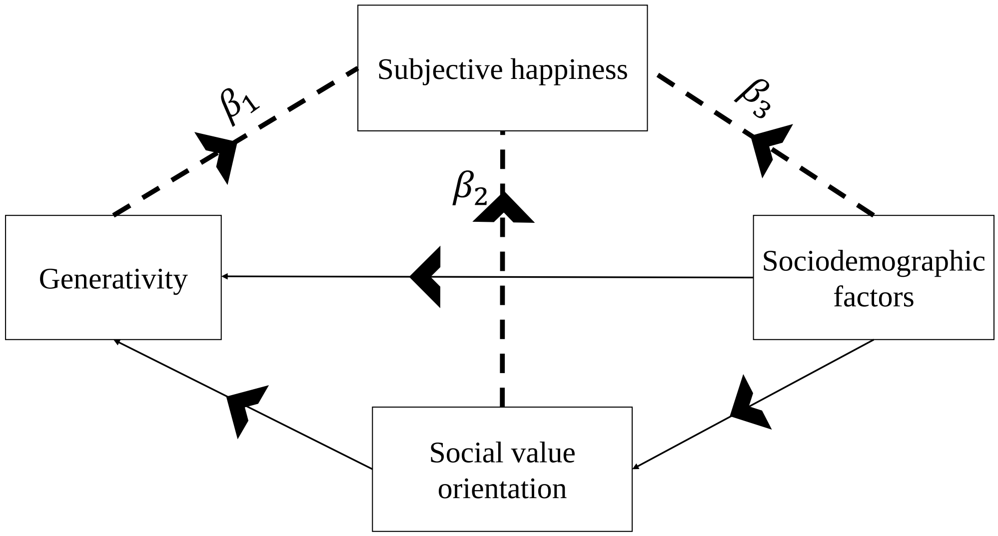


Figure 2.2: A conceptual framework for the relationships among subjective happiness, generativity, social value orientation and sociodemographic factors.

2.3 Results

Table 2.1 presents basic statistics of generativity, social value orientation (SVO), sociodemographic variables and subjective happiness (SH) for urban subjects (Dhaka), rural subjects (Bogra and Gaibandha) and all subjects in the sample. The mean score of subjects' generativity in the urban area, rural areas and overall sample are fairly similar at 28.57 points $(\text{SD} = 12.3)$, 29.25 points $(\text{SD} = 11.88)$ and 29.09 points $(\text{SD} = 11.98)$, respectively. In contrast, SVO is different among the urban area, rural areas and overall sample, as the percentages of proself subjects are 84%, 64% and 70%, respectively. The result is consistent with the previous literature in the sense that the percentage of proself people becomes higher in urban areas than in rural areas Shahrier et al. (2016); Timilsina et al. (2017, 2019a). Another difference is in the average year of education, as urban subjects have 12.68 years $(\text{SD} = 4.91)$, rural subjects have 8.97 years $(\text{SD} = 3.86)$ and overall subjects in the sample have 9.95 years $(\text{SD} = 4.47)$ on average.

The largest variation in the sample is found in average household income, as it is 47.7 thousand

Table 2.1: Summary statistics

	Urban (Dhaka)					Rural (Bogra and Gaibandha)					Overall				
	Mean	Median	SD	Min	Max	Mean	Median	SD	Min	Max	Mean	Median	SD	Min	Max
Generativity [1]	28.57	28	12.30	6	66	29.25	29	11.88	2	70	29.07	29	11.98	2	70
SVO															
Proself [2]	0.84	-	0.37	0	1	0.64	-	0.48	0	1	0.70	-	0.46	0	1
Competitive	0.22	0	0.42	0	1	0.29	0	0.45	0	1	0.27	0	0.44	0	1
Individualistic	0.62	1	0.49	0	1	0.36	0	0.48	0	1	0.42	0	0.49	0	1
Prosocial	0.16	0	0.37	0	1	0.36	0	0.48	0	1	0.30	0	0.46	0	1
Age															
(< 20)	0.68	1	0.47	0	1	0.49	0	0.50	0	1	0.54	1	0.5	0	1
$(20 - 29)$	0.25	0	0.43	0	1	0.26	0	0.44	0	1	0.25	0	0.44	0	1
$(30 - 39)$	0.04	0	0.18	0	1	0.11	0	0.31	0	1	0.09	0	0.29	0	1
$(40 - 49)$	0.04	0	0.18	0	1	0.08	0	0.27	0	1	0.07	0	0.25	0	1
$(50 - 59)$	0	0	0	0	0	0.05	0	0.23	0	1	0.04	0	0.19	0	1
(> 60)	0	0	0	0	0	0.01	0	0.11	0	1	0.008	0	0.09	0	1
Years of education	12.68	16	4.91	0	20	8.97	10	3.86	0	17	9.95	10	4.47	0	20
Household income in thousands	47.73	30	49.02	7	300	16.56	12	21.41	0.50	250	24.81	15	34.02	0.50	300
Gender [3]	0.16	-	0.37	0	1	0.04	-	0.21	0	1	0.07	-	0.26	0	1
Religion [4]	0.07	-	0.26	0	1	0.01	-	0.09	0	1	0.02	-	0.15	0	1
No. of siblings [5]	4.05	4	2.14	1	11	4.54	4	2.34	1	14	4.41	4	2.30	1	14
Family structure [6]	0.30	0	0.46	0	1	0.38	0	0.49	0	1	0.36	0	0.48	0	1
Rural (Bogra and Gaibandha) [7]	-	-	-	-	-	-	-	-	-	-	0.74	1	0.44	0	1
Subjective happiness scales (SHS)															
Absolute self-rated happiness (AH)	4.91	5	1.36	1	7	4.79	5	1.44	1	7	4.82	5	1.42	1	7
Peer relative happiness (PRH)	5.08	5	1.42	1	7	4.66	5	1.51	1	7	4.77	5	1.50	1	7
General subjective happiness (GSH)	5.22	5	1.47	1	7	4.82	5	1.38	1	7	4.93	5	1.42	1	7
General subjective unhappiness (GSU)	2.72	2	1.68	1	7	3.38	3	1.66	1	7	3.21	3	1.69	1	7
Overall subjective happiness (OSH)	5.12	5.25	0.99	2.50	7	4.72	4.75	1.05	1.50	7	4.83	4.75	1.05	1.50	7
Observations	105					292					337				

[1] Generativity is defined as a count variable that takes values from 0 to 70 based on how many activities subjects have done in the last two months from a generativity behavior checklist.

[2] Proself is a dummy variable for SVO, and it takes the value of 1 if the subject is characterized as individualistic or competitive and 0, otherwise.

[3] Gender is a dummy variable that takes a value of 1 when the subject is male and 0, otherwise.

[4] Religion is a dummy variable that takes a value of 1 when the subject is non-Muslim and 0, otherwise.

[5] No. of siblings is a count variable for the number of siblings.

[6] Family structure is a dummy variable that takes a value of 1 when it is a joint family and 0, otherwise.

[7] Rural is a dummy variable that takes a value of 1 when a subject is living in Bogra and Gaibandha and 0 otherwise.

BDT (SD $= 49.02$), 16.6 thousand BDT (SD $= 21.41$) and 24.81 thousand BDT (SD $= 34.02$) in the urban area, rural areas and overall sample, respectively. Regarding happiness, urban subjects have a higher SH in the four scales of the subjective happiness scale than rural subjects and overall subjects in the sample, leading the overall subjective happiness (OSH) to be higher for urban subjects with an average of 5.12 points (SD $= 0.99$) than rural subjects with an average of 4.72 points (SD $= 1.05$) and overall subjects in the sample with an average of 4.83 points (SD $= 1.69$). These statistics suggest that urban subjects may generally have a higher level of SH than rural subjects, regardless of happiness scales, which is in line with Requena and Kim Requena (2015); Kim (2018).

Figure 2.3 is a histogram to present the distribution of OSH for overall subjects in the sample, where the vertical axis denotes the frequencies, and the horizontal axis denotes OSH. The highest spike is found between 4.5 and 5 points, and the distribution appears to follow a normal distribution but is slightly skewed on one side (almost a bell-shaped distribution). We run a Shapiro–Francia normality test with the null hypothesis that the OSH distribution is normal. The result shows that the null hypothesis is not rejected, even with a $10\,\%$ significance level, meaning that the OSH distribution follows a normal distribution. Therefore, we run an ordinary least squares (OLS) regression for OSH, while other happiness scales are analyzed by applying Poisson regressions. Figure 2.4 presents a scatterplot between OSH (vertical axis) and generativity (horizontal axis), where one dot represents an observation for each subject in our sample. This scatterplot appears to suggest that there is a positive association between the two, and we confirm that there is a positive association between OSH and generativity using Pearson correlation $(r = 0.11, p < 0.03)$.

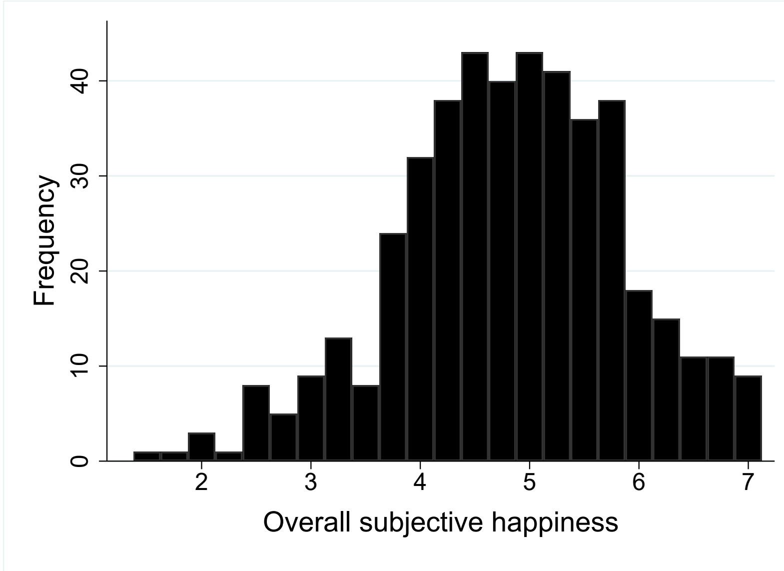


Figure 2.3: Frequency distribution of overall subjective happiness (OSH).

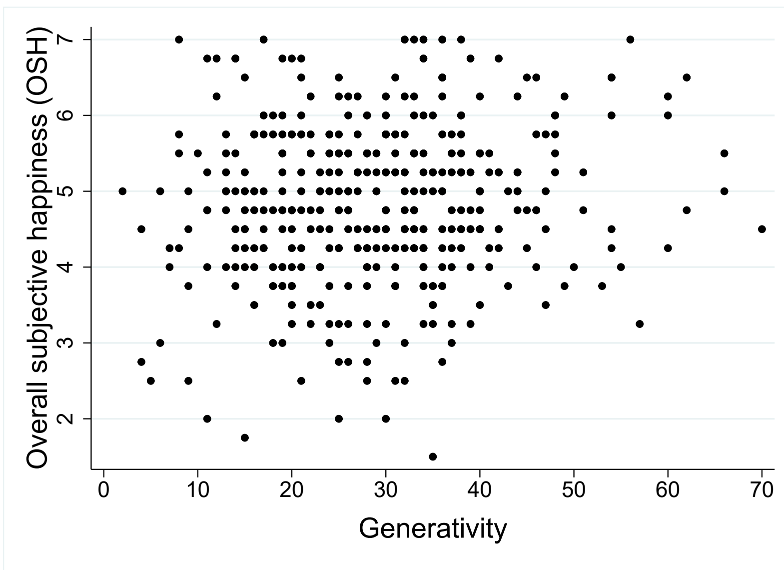


Figure 2.4: A scatterplot between overall subjective happiness (OSH) and generativity.

Figure 2.5 is a boxplot to demonstrate a difference in OSH distributions between prosocial and proself subjects. The OSH distribution in proself subjects is slightly higher than that in prosocial subjects with respect to the medians and supports. To statistically check the distributional difference, we run a Mann–Whitney test with the null hypothesis that the OSH distributions between proself and prosocial subjects are the same. The result shows that there is no significant difference in the OSH distributions between prosocial and proself subjects $(Z = -0.426, p = 0.67)$. We next examine the relationship between OSH and key sociodemographic factors, such as household income and residence areas. The Pearson correlation coefficients demonstrate that OSH and household income (residence area) have a positive (negative) association with $r = 0.18, p < 0.01$ $(r = -0.15, p < 0.01)$. Figure 2.6 is a boxplot to visualize a difference in the OSH distributions between rural and urban subjects, showing that urban subjects tend to have higher OSH than rural subjects. The Mann–Whitney test confirms that there is a significant difference in OSH distributions $(Z = 3.38, p < 0.01)$ between urban and rural subjects. Overall, these statistical analyses suggest that generativity, income and residence area could be considered possible determinants of subjective happiness, while SVO may not.

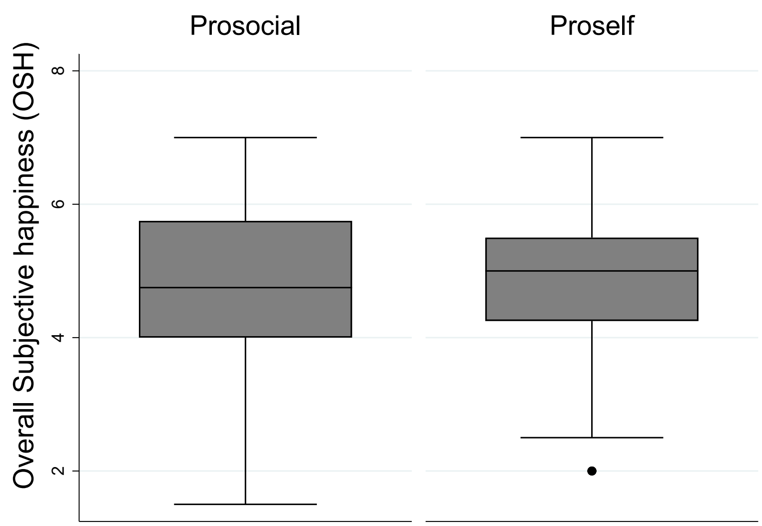


Figure 2.5: A boxplot between overall subjective happiness (OSH) and social value orientation (SVO), where black dots represent outliers

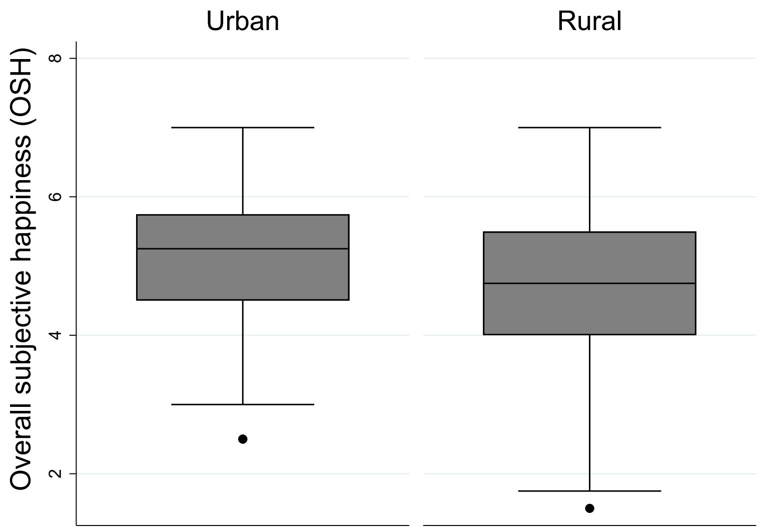


Figure 2.6: A boxplot between overall subjective happiness (OSH) and residence areas, where the black dot represents outliers

We conduct regression analyses to quantitatively understand how SH is characterized by generativity, SVO, household income and residence area, controlling for other sociodemographic factors (see Table 2.2). We have tried different specifications for the regression models to check the robustness of our results, confirming that the main results in Table 2.2 remain the same. The first four columns in Table 2.2 present the marginal effects of the independent variables on the four components of the subjective happiness scale, such as absolute self-rated happiness (AH), peer relative happiness (PRH), general subjective happiness (GSH) and general subjective unhappiness (GSU), using Poisson regressions, and the last column shows the marginal effect on overall subjective happiness (OSH) using OLS. The results reveal that generativity is statistically significant (i.e., $p < 0.05$ except in AH regression $p < 0.10$ and $p < 0.01$ in GSH regression) across the four different scales of SH and OSH. More specifically, the expected AH, PRH and GSH increase by 13.4 %, 15.8 % and 31.1 %, respectively, and GSU declines by 18.8 %, with a rise in subjects' generativity score by one standard deviation (SD). The relationship between OSH and subjects' generativity score is consistent with the four scales of SH, as OSH increases by 0.106 points when subjects' generativity score increases by one SD. These results show that generativity is a consistent and robust determinant across all scales of SH and OSH, indicating that subjects' generativity could be one of the most important factors of their happiness.

Table 2.2 shows that residence area and household income are the only sociodemographic factors that show statistical significance and are associated with different subjective happiness scales. The PRH and OSH for rural subjects are 41 % and 0.25 points lower, respectively, than these for urban subjects (As mentioned in Section 2.2, the marginal effect of a dummy variable on PRH (OSH) is calculated by the following formula: $\exp(\beta_j) - 1$, where β_j is an estimated coefficient for the dummy variable. For instance, $\exp(0.347) - 1 \approx 0.41 = 41\,\%$). An increase in household income by 10 BDT is associated with a rise in GSH and OSH by 5 % and 0.04 points, respectively. We also calculate the marginal rate of substitution (MRS) between household income and generativity by taking the natural logarithm for overall subjective happiness, generativity and household income and rerunning OLS regression. We obtain MRS $= \frac{\text{Percent change in generativity}}{\text{Percent change in income}} = -1.14$, meaning that, to maintain the same level of happiness, one percent of household income must be substituted by 1.14 percent of generativity or vice versa. This indicates that the effect of generativity is economically significant because it has almost the same magnitude as the effect of household income. The results demonstrate that generativity, urban/rural difference and household income are main determinants of SH, which can be considered to be in line with the previous literature. de St. Aubin and McAdams (1995) find that generativity is positively correlated with SH, and Ball and Chernova (2007) demonstrate that there is a strong positive relationship between income and SH. In developing countries, Requena (2015) confirms that subjects in urban areas have a higher level of SH than subjects in rural areas.

2.4 Discussion

Generativity is demonstrated to be a robust and consistent determinant of SH, while SVO is not. The previous literature demonstrates that prosocial actions (not preferences) lead to an increase in happiness (Dunn et al., 2008; Konow, 2010; Dunn et al., 2014; Koch, 2015), while there is little research that examines people's happiness with different social value orientations or preferences. It is generally considered that proself and prosocial people may have their own way to be happy and tend to

Table 2.2: Regression results.

Variables	Poisson Regression (1) Absolute Self-Rated Happiness (AH)	Poisson Regression (2) Peer Relative Happiness (PRH)	Poisson Regression (3) General Subjective Happiness (GSH)	Poisson Regression (4) General Subjective Unhappiness (GSU)	OLS (5) Overall Subjective Happiness (OSH)
Standardized values of generativity	0.134 *	0.158 **	0.311 ***	−0.188 **	0.106 **
	(0.069)	(0.073)	(0.077)	(0.094)	(0.053)
Proself	0.233	−0.008	−0.086	0.109	0.062
	(0.167)	(0.168)	(0.160)	(0.201)	(0.124)
Rural (Bogra and Gaibandha)	−0.054	−0.347 *	−0.251	−0.367	−0.257 *
	(0.197)	(0.188)	(0.181)	(0.224)	(0.132)
Age	0.146	0.0013	0.0863	0.0932	0.0801
	(0.171)	(0.179)	(0.172)	(0.208)	(0.126)
Age square	−0.019	0.036	−0.013	−0.009	−0.0006
	(0.046)	(0.043)	(0.044)	(0.052)	(0.030)
Years of education	−0.0122	0.0135	−0.0007	0.0207	0.005
	(0.018)	(0.020)	(0.019)	(0.021)	(0.014)
Household income in thousand	0.003	0.002	0.005 ***	0.004	0.004 **
	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)
Female	0.436	0.152	0.223	0.07	0.229
	(0.300)	(0.359)	(0.343)	(0.348)	(0.231)
Religion	−0.0157	−0.102	−0.342	0.521	0.0307
	(0.405)	(0.551)	(0.582)	(0.500)	(0.385)
No. of siblings	0.0011	−0.0293	−0.0611	−0.0207	−0.0274
	(0.035)	(0.038)	(0.038)	(0.039)	(0.025)
Family structure	0.168	0.0237	0.0487	−0.259	−0.006
	(0.152)	(0.156)	(0.145)	(0.190)	(0.107)
Observations	397	397	397	397	397
Wald χ^2	11.73	19.25 *	44.55 ***	26.07 ***	29.30 ***
Pseudo R^2	0.0036	0.0053	0.0102	0.0087	0.065

*** $P < 0.01$, ** $P < 0.05$, * $P < 0.10$. Numbers in parentheses are standard errors.

consistently make proself and prosocial choices, respectively, because the proselves (prosocials) become happier by being more proself (prosocial) than by being more prosocial (proself). However, we conjecture that the magnitude of a change in individual SH may not be characterized by SVO or be different between prosocial and proself people, based on the fact that the SVO variable is insignificant in our analyses. Rather, the magnitude of a change in individual SH may be more attributed to something more personal or person-specific factors such as self-esteem, self-positivity or self-efficacy, along with SVO.

Generativity is calculated by the scores of how many activities from the generativity behavioral checklist (GBC) people have taken in the last two months. The GBC contains certain activities that both prosocial and proself people are likely to perform in their daily lives. Some activities in the GBC such as "learned a new skill," "produced a plan for an organization or group outside my family" and "was elected or promoted to a leadership position" may be likely to be performed by proself people. On the other hand, the activities in the GBC such as "gave money to a charity," "taught somebody a skill" and "made something for somebody and then gave it to them" may be likely to be performed by prosocial people.

It appears that there are mainly two channels of motivations to be more generative for future generations: (i) proself and (ii) prosocial channels, implying that the basic motives behind generative actions could be different. Proself people may be driven by "legacy motives," whereas prosocial people may be driven by "motives of helping hands" for future generations (Bang et al., 2017; Wade-Benzoni, 2019; Timilsina et al., 2019a). Therefore, it is our conjecture that generative actions may be able to uniformly contribute to individual SH, irrespective of prosocial and proself motives behind the actions, and, therefore, generativity is a consistent and robust determinant of SH in the analysis. If this is the case, future design approach and/or some other social devices suggested by Kamijo et al. (2017); Nakagawa et al. (2017); Shahrier et al. (2017b); Hara et al. (2019); Timilsina et al. (2019b); Saijo (2020) will play a significant role in connecting the current generation to future generations as a possible institutional framework to increase or maintain the generativity for intergenerational wellbeing and sustainability.

Our results also show that PRH and OSH vary by residence area and that urban people have higher

PRH and OSH than rural people. Life in a rural society is known to be homogeneous in terms of choice sets, social status and sources of happiness (A PRH question in the GBC uses a 7-point Likert scale, and its anchors are "less happy" and "more happy." This means that the middle point of the scale (e.g., score of 4) describes the subject who is "as happy as his/her peers." An average PRH for rural subjects is closer to four points than that for urban subjects, implying that rural subjects might feel closer to being "as happy as their peers" than urban ones). For instance, a main and common entertainment among rural people in Bangladesh is attending a social gathering, "mela," in which all people in the village can come and gather at the same time and place. In that gathering, people enjoy all the social and communal activities together by sharing a feeling of "commonality." On the other hand, urban areas are heterogeneous in terms of choice sets, social status and sources of happiness, as there are more possibilities in many aspects. For instance, entertainment in urban areas includes wider varieties with more accessibility, giving people more freedom in their choices. In this type of urban environment, people can express different preferences and value judgments over what to do and how to spend, inducing themselves to see a "difference" in how each person is distinct from one another. Therefore, urban people may be able to consider themselves as happy in their own way because they are considered to have chosen to be so, leading urban people to feel happier compared to their peers than rural people.

Cities are predicted to expand and grow with further urbanization over the next 50 years, and 65–75% of the earth's population will reside in cities in Asia and Africa (American Association for the Advancement of Science, 2016; Wigginton et al., 2016). Economic theory establishes that urbanization brings about an increase in people's income, potentially implying that economic growth with urbanization has a positive effect on happiness along with our result as well as those of the previous literature (Wheaton and Lewis, 2002; Bloom et al., 2008; Zhang, 2011; Requena, 2015; Han and Kim, 2019; Lin et al., 2019). However, behavioral sciences and social psychology report that urbanization is changing human societies in the way that people's generativity declines, the so-called "generativity crisis" (Sasaki, 2004; Timilsina et al., 2019a). Sasaki (2004) claims that rapid economic growth, urbanization and social changes in Japan have led to a decline in people's generativity. Other scholars argue that the degrowth of economies is inevitable to ensure the wellbeing of future generations (Weitzman, 1997; Schneider et al., 2010; Alexander, 2012; Andreoni and Galmarini, 2014; Buchs and Koch, 2019). Given the two possible paths of growth and degrowth, a natural question arises: "which is better, economic growth with urbanization or degrowth for the current and future generations' wellbeing?" Our results in this research clearly suggest that the answer depends on whether and how economic growth with urbanization (and/or degrowth) affects generativity and in turn sustainability, which should be addressed and established in future research.

2.5 Conclusions

This paper has analyzed the relationships among subjective happiness (SH), generativity and social preferences within a single analytical framework, posing a research question "Are people happier by being prosocial and/or generative for sustainability?" We conduct a survey experiment, collecting data from five subjective happiness scales, generativity, SVO and sociodemographic variables in an urban city (Dhaka) and rural areas (Bogra and Gaibandha) in Bangladesh. With the data, we empirically characterize determinants of SH with a specific focus on generativity and SVO, controlling for other factors. The statistical analysis shows a positive association between SH and generativity, irrespective of the type of happiness scale, while SVO does not exhibit any significant effect. Rural people have lower peer relative happiness than urban people, and household income has a positive relationship with general subjective happiness, leading each of these factors to be significant in overall subjective happiness. In summary, generativity, income and residence area are main determinants of happiness, implying that further urbanization, which is expected to occur in the future, will positively affect people's happiness if it can bring about an increase in generativity. It has been claimed that democracy and capitalism are not institutions that can maintain sustainability when people pursue happiness, and there are no social institutions or regimes to be able to do so (Hanley et al., 2006; Schumpeter, 2008). This is exemplified by the emergence of "climate change" and "accumulation of government debts" in many countries for the last decades. Our paper contributes to the existing knowledge by answering whether or not people become happier by being more generative. The answer is identified to be "yes," and thus the "future design," which seeks to connect the current generation with future generations, shall be considered and recommended as a promising institution to maintain sustainability through enhancing generativity along with happiness (Hara et al., 2019; Saijo, 2020).

Chapter 3

Does perspective-taking promote intergenerational sustainability?

3.1 Introduction

A social dilemma refers to a situation where every individual in a group or society behaves according to her self-interest without cooperating with one another, leading to a failure of maximizing the social welfare (Dawes, 1980). The provisions of public goods and common pool resources are considered to be intra- and inter-generational social dilemmas, and literature finds that communication enhances cooperation, leading to Pareto improvement and socially optimal outcomes (Ostrom, 1990; Chen and Komorita, 1994; Mason and Phillips, 1997; Mantilla, 2015; Ozono et al., 2020). The long-run survival of humankind on Earth is claimed to depend on whether or not we can resolve intergenerational dilemmas and maintain resources by making communication and cooperation across different generations, i.e., intergenerational sustainability (IS) problems (Ehrlich et al., 2012; Steffen et al., 2015; Shahrier et al., 2017c). However, some authors claim that it is quite challenging to make such communication and cooperation across different generations, when they are neither interacting nor overlapping (González-Ricoy and Gosseries, 2016; Krznaric, 2020). Therefore, IS problems have occurred reflecting the lack of such communication and cooperation such as climate change, sea-level rise, accumulation of public debt and biodiversity loss (Greenhalgh, 2005; Hansen and İmrohoroğlu, 2016; Steffen et al., 2018; Bamber et al., 2019). A key question here is "does the growing threat of IS problems induce societies and individuals to take cooperative actions when communications among generations are difficult or impossible?" (Barkenbus, 2010; Lenton et al., 2019). Given this state of affairs, this paper addresses how individuals cooperatively behave for maintaining IS.

We consider intergenerational sustainability dilemma (ISD) to represent a typical situation where the current generation chooses to maximize (sacrifice) its own benefits without (for) considering future generations, compromising (maintaining) IS where communications among generations cannot be made (Kamijo et al., 2017; Shahrier et al., 2017c). One of the main features in ISD is its unidirectional or irreversible nature, as the current generation affects future generations, but the opposite is not true. Thus, ISD can be considered to have a similar structure to a dictator game (DG) in which a dictator unidirectionally affects a recipient. In the unidirectional setting, the current generation (or the dictator) can prioritize its own benefits without considering future generations (or receivers). The DG has been widely studied by social scientists for the last few decades (Bohnet and Frey, 1999; Dana et al., 2006; Bardsley, 2007; List, 2007; Ekeli, 2009; Thompson, 2010; Macro and Weesie, 2016; Koch et al., 2017). The stake represents the economic factor in the DG and is observed to be an influential factor in the allocations between the dictator and a receiver (Hoffman et al., 1996; Cherry et al., 2002; List and Cherry, 2008; Novakova and Flegr, 2013; Raihani et al., 2013). Engel (2011) reviews 440 DG papers in a meta-study, identifying that the stake usually falls between $0\,\$$ and $130\,\$$, and an increase in the stake reduces dictators' willingness to give. Other researchers have focused on how information on the allocations of other dictators affects a dictator's allocation in the DG (Hoffman et al., 1994; Cason and Mui, 1998; Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000; Diekmann, 2004; Herne et al., 2013). Ben-Ner et al. (2004) find that information about the allocations of other dictators leads a dictator to divide the allocation in a similar way to how other dictators make their allocations. In short, previous studies have shown that the economic factor and information about other dictators' allocation influence allocations in the DG.

Many scholars have applied an experimental approach in examining group behaviors regarding IS. Fischer et al. (2004) implement a common pool resource experiment with university students to investigate individual decisions in a group, demonstrating that the existence of subsequent groups motivates individuals to sustain resources. Hauser et al. (2014) conduct an online intergenerational goods experiment under a voting mechanism using a general subject pool and find that voting could reduce the exploitation of resources by restraining defectors when a majority of subjects are prosocial. Sherstyuk et al. (2016) examine the efficiency of a dynamic externality game in the laboratory, identifying that resolving the dynamic externalities becomes more challenging in intergenerational settings than in settings with infinitely lived decision makers. They also claim that access to information on the history of previous generations' decisions may improve the negative externalities. Kamijo et al. (2017) design and implement an ISD game (ISDG) in the laboratory with a student pool to understand group behaviors in the ISD. They find that, within a group of three individuals, the introduction of an individual who is asked to play the role of deputy for future generations, called an imaginary future person, enhances IS. Shahrier et al. (2017c,a) conduct an ISDG field experiment using a subject pool drawn from the general public in urban and rural areas of Bangladesh, showing that rural groups choose sustainable options more often than do urban groups, as the majority of rural people are prosocial. Moreover, they find that inducing subjects to take and understand the perspective of the next generation before making their decision, an institution called the future ahead and back mechanism, improves IS. Shahrier et al. (2017c,a) note that introducing an imaginary future person in a group is not effective at maintaining IS with a general subject pool of Bangladeshi people in the ISDG field experiments. Therefore, they institute and design a future ahead and back mechanism. Overall, group behaviors in IS are mainly affected by social preferences, access to information about the decisions of previous generations (i.e., history) and institutions or environments for group decisions.

Past studies suggest that individual behaviors in the DG and group behaviors in the ISD are influenced by not only people's social preferences of prosociality but also information about the allocations of other dictators and the decisions of previous generations, respectively. We call such information the retrospective factor for decisions in the ISD. On the other hand, how the current generation affects future generations also alters people's behaviors in the ISD. We call this effect of the current generation's choice on future generations the prospective factor for decisions in the ISD. This study systematically examines how individuals behave in response to the retrospective and prospective factors in the ISD and derive some implications for designing our societies to be intergenerationally sustainable. To this end, we design and institute a one-person ISD game (ISDG) with a strategy method in which a queue of individuals is organized as a generational sequence. Each individual is asked to choose either (i) an unsustainable option that yields payoff X, imposing an irreversible cost on future generations of D, or (ii) a sustainable option that yields payoff $(X - D)$, without imposing any cost on future generations, in 36 situations where the histories of previous generations' choices (the retrospective factor) and the payoff structures of $\frac{X}{D}$ (the prospective factor, i.e., the IS index) are varied. As a potential resolution of the ISD, we introduce a future ahead and back (FAB) mechanism whereby first, each individual is asked to take the position of the next generation and to request what she wants the current generation to choose and second, she makes the actual decision from the original position.

The economic factor and information about how other dictators make their allocations in the DG have been established to affect the allocations between a dictator and a receiver along with people's social preferences. Likewise, the economic factor (i.e., $\frac{X}{D}$) and histories of previous generations' decisions in the ISD are hypothesized to affect the allocations of the decisions made by the current generation between herself and the next generation, consequently influencing subsequent generations and IS. The ratio in ISD is interpreted to represent how many generations can enjoy the positive amount of resources before reaching the "devastating consequence" of resource extinction (i.e., $X = 0$), when all the current and subsequent generations keep choosing unsustainable options. Therefore, it is very important and can be considered similar to an idea of the "tipping point" in the ecological system (Westley et al., 2011; Steffen et al., 2015, 2018). However, there is a distinction between the DG and the ISDG in that a dictator unidirectionally affects only one receiver, while the current generation unidirectionally affects not only the next generation but also all subsequent generations. To the best of our knowledge, no previous research has systematically addressed and examined individual behaviors under various situations of the ISD. Specifically, the novelties of this research lie in (i) characterizing how individuals with different social preferences behave to be sustainable or unsustainable in response to the economic (the prospective) factor and history of previous generations' decisions (the retrospective factor) under the ISD and (ii) evaluating how effective an FAB mechanism that induces people to take the standpoint of future generations is at maintaining IS.

3.2 Methods and materials

We administered a one-person intergenerational sustainability dilemma game (ISDG), social value orientation (SVO) game and questionnaires to collect data on individual behaviors, social preferences and sociodemographic information from subjects.

3.2.1 One-person intergenerational sustainability dilemma game (One-person ISDG)

We designed and implemented a one-person ISDG, which possesses similar structures to those of the ISDG played by a group of three people in Kamijo et al. (2017) and Shahrier et al. (2017c). A one-person ISDG is organized by queuing a sequence of consecutive generations, and each generation is represented by one person. A generation is asked to make a choice between an unsustainable option A and a sustainable option B. If a generation chooses option A, she receives a payoff of X tokens (hereafter, we skip mentioning "tokens"), and the next generation faces the decision environment where the payoffs associated with options A and B uniformly decrease by D. If a generation chooses option B, she receives a payoff of $X - D$, and the next generation has the same decision environment as the current one, where the payoffs associated with options A and B never decrease. An essential feature of the game is that the current generation affects subsequent generations, while the opposite is not true.

The 1st generation always starts a one-person ISDG with option $A = 3600$ and option $B = 3600 - D$ in any situation. Suppose that a subject is the 1st generation and plays the game with $D = 900$ in a specific situation. The 1st generation receives 3600 if she chooses option A, and the 2nd generation plays the game with options $A = 2700$ and $B = 1800$. When the 1st generation chooses option B, she receives 2700 and the 2nd generation plays the game with options $A = 3600$ and $B = 2700$. Next, suppose that a subject is the 5th generation and plays the game with $D = 300$ in another situation, given a history that the 1st and 3rd (2nd and 4th) generations chose option A (B). In this case, the 5th generation faces the decision environment where the payoffs associated with options A and B are 3000 ($= 3600 - 2D = 3600 - 2 \times 300$) and 2700, respectively, noting that the two previous generations

Table 3.1: The 35 situations that each subject plays in one-person ISDG

Situations	% of option Ain history	X	D	$\frac{X}{D}$	# of generations in history	Current generation		
						Position[1]	Option A	Option B
1	0	3600	1800	2	0	1	3600	1800
2	0	3600	1200	3	5	6	3600	2400
3	0	3600	900	4	7	8	3600	2700
4	0	3600	300	12	0	1	3300	3300
5	0	3600	100	36	9	10	3600	3500
6	0.25	2700	900	3	4	5	2700	1800
7	0.25	1800	300	6	8	9	1800	1500
8	0.25	3400	200	17	4	5	3400	3200
9	0.33	0	1200	0	9	10	0	-1200
10	0.33	1200	600	2	12	13	1200	600
11	0.5	0	1800	0	4	5	0	-1800
12	0.5	0	900	0	8	9	0	-900
13	0.5	1200	1200	1	4	5	1200	0
14	0.5	2400	600	4	4	5	2400	1800
15	0.5	2400	600	4	4	5	2400	1800
16	0.5	2400	300	8	8	9	2400	2100
17	0.5	3400	200	17	2	3	3400	3200
18	0.5	3200	100	32	8	9	3200	3100
19	0.63	2600	200	13	8	9	2600	2400
20	0.67	1200	1200	1	3	4	1200	0
21	0.67	3000	300	10	3	4	3000	2700
22	0.67	2600	100	26	15	16	2600	2500
23	0.7	1500	300	5	10	11	1500	1200
24	0.7	2200	100	22	20	21	2200	2100
25	0.75	0	300	0	16	17	0	-300
26	0.75	900	900	1	4	5	900	0
27	0.75	1800	600	3	4	5	1800	1200
28	0.75	3300	100	33	4	5	3300	3200
29	0.78	0	200	0	23	24	0	-200
30	1	1800	1800	1	1	2	1800	0
31	1	1800	900	2	2	3	1800	900
32	1	2400	1200	2	1	2	2400	1200
33	1	3300	300	11	1	2	3300	3000
34	1	3000	200	15	3	4	3000	2800
35	1	3500	100	35	1	2	3500	3400

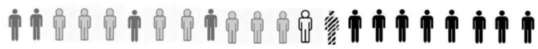
[1] This represents current generation position in a situation. For example, in situation number 23, the number of generations in history is 10, thus current generation position is the 11th generation.

choose option A. Therefore, the 5th generation receives 3000 if she chooses option A, and the 6th generation plays the game with options $A = 2700$ and $B = 2400$. If the 5th generation chooses option B, she receives 2700, and the 6th generation plays the game with options $A = 3000$ and $B = 2700$.

A strategy method is applied to create 36 different one-person ISDG situations that each subject goes through (Selten, 1967). Specifically, the strategy method applied in this research follows a conditional information lottery (CIL) method (Bardsley, 2000; Bardsley and Sausgruber, 2005). The CIL method enables us to create some fictional situations and one real situation where subjects can not distinguish between the fictional ones and real one. The 36 situations in this experiment consist of 35 fictional situations, which are uniformly applied for all the subjects, and one real situation (i.e. binding situation), which is different for each subject. In the 35 situations, the history of previous generations' choices, the payoff of X that a generation can receive, a payoff difference of D between options A and B and the ratio between X and D (i.e., $\frac{X}{D}$) are parametrized under the assumptions that the 1st generation always starts the one-person ISDG with options $A = 3600$ and $B = 3600 - D$ and that the value of D remains the same in each situation. Table 3.1 summarizes the 35 different situations in the one-person ISDG, listing the associated percentages of previous generations that choose unsustainable option A in history, ranging from 0 to 1; the payoff X that a generation can receive, ranging from 0 to 3600; the difference D, ranging from 100 to 1800; and the ratio between X and D, ranging from 0 to 36. Although table 3.1 contains the percentage of previous generations in history for each situation that chose option A as a summary, a subject is shown a whole history of how each previous generation chose between options A or B, displayed by a sequence of human-shaped icons with different colors in each situation as shown in tables 3.2 and 3.3.

Figure 3.1 displays a scatter plot for the distribution of the 35 situations over the percentage of previous generations who choose option A and the ratio between X and D, where each plot corresponds to one situation in table 3.1. In this experimental design, the history of the sequence for each situation and the ratio between X and D for each situation can be interpreted as the retrospective and prospective factors because they represent what happened in the past as well as what will happen to the subsequent generations in the sequence for each situation, respectively. Specifically, the history of the sequence for each situation is interpreted as the retrospective factor, while the ratio of $\frac{X}{D}$ is interpreted as the prospective factor, representing how many generations in the sequence can receive a positive payoff of X for each situation when each generation keeps choosing option A. We call the ratio of $\frac{X}{D}$ the intergenerational sustainability index (i.e., IS index) in the one-person ISDG. The parametrization is made to widely vary the retrospective (history) and prospective ($\frac{X}{D}$) factors as well as to minimize the correlation among the factors in the one-person ISDG with a strategy method, reflecting figure 3.1 ($r = 0.099, P = 0.56$). For example, the 23rd situation in table 3.1 consists of a history in which $70\,\%$ of previous generations chose option A, $X = 1500$ and $D = 300$, implying that the current generation is 11th and there are 10 previous generations. Concretely, the history consists of 7 previous generations

Table 3.2: Detailed descriptions with human-shaped icon displays in history from 1 to 21 situations within the 35 ones as seen by each subject

Situations	Human-shaped icons in history	% of option A in history	X	D	X/D
1		0	3600	1800	2
2		0	3600	1200	3
3		0	3600	900	4
4		0	3600	300	12
5		0	3600	100	36
6		0.25	2700	900	3
7		0.25	1800	300	6
8		0.25	3400	200	17
9		0.33	0	1200	0
10		0.33	1200	600	2
11		0.50	0	1800	0
12		0.50	0	900	0
13		0.50	1200	1200	1
14		0.50	2400	600	4
15		0.50	2400	600	4
16		0.50	2400	300	8
17		0.50	3400	200	17
18		0.50	3200	100	32
19		0.63	2600	200	13
20		0.67	1200	1200	1
21		0.67	3000	300	10

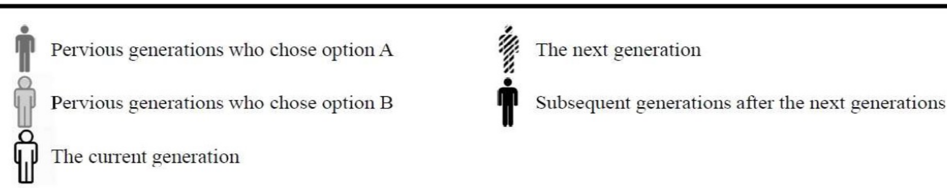


Table 3.3: Detailed descriptions with human-shaped icon displays in history from 22 to 35 situations within the 35 ones as seen by each subject (continuum from where we left off in table 3.2)

Situations	Human-shaped icons in history	% of option A in history	X	D	X/D
22		0.67	2600	100	26
23		0.70	1500	300	5
24		0.70	2200	100	22
25		0.75	0	300	0
26		0.75	900	900	1
27		0.75	1800	600	3
28		0.75	3300	100	33
29		0.78	0	200	0
30		1	1800	1800	1
31		1	1800	900	2
32		1	2400	1200	2
33		1	3300	300	11
34		1	3000	200	15
35		1	3500	100	35

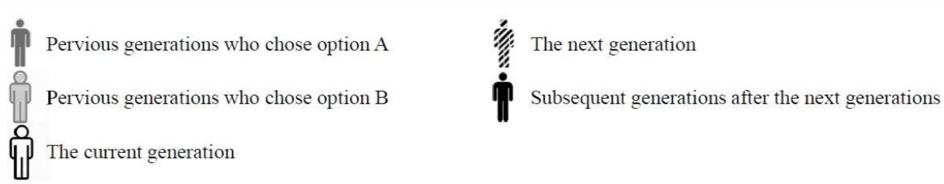
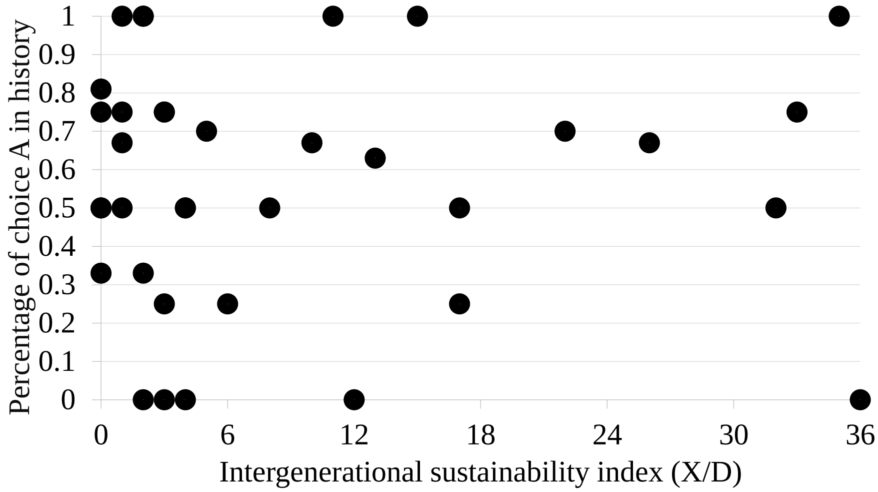


Figure 3.1: Scatter plot for the distribution of the 35 situations in our game



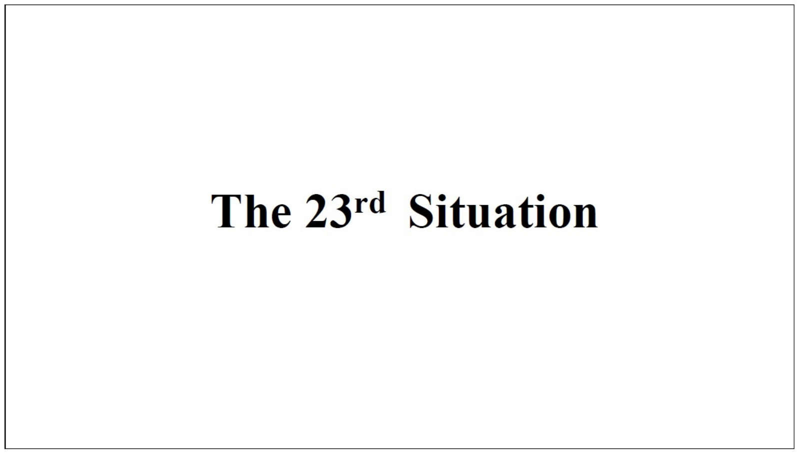
(i.e., 1st, 2nd, 4th, 6th, 8th, 9th and 10th) that chose option A and of 3 previous generations (i.e., 3rd, 5th, 7th) that chose option B, as shown in figure 3.2. In this case, the payoffs associated with options A and B that the 11th generation faces are 1500 ($= 3600 - 7D = 3600 - 7 \times 300$) and 1200, respectively.

Figure 3.2 shows the screens of the game, which are designed following Strombach et al. (2015). In each situation, a subject observes the screen of the game when she is asked to decide between options A and B. Here, we take the 23rd situation as an example. The first screen in figure 3.2 notifies the subject of the situation number (i.e., the 23rd situation), and the second screen presents the history, options and associated payoffs for the current and next generations. At the top of the second screen, human-shaped icons represent the generations in each situation, and the dotted and striped icons represent the current and subsequent generations, respectively. The gray and light gray icons represent the previous generations in history who chose options A and B, respectively, while the black icons represent the subsequent generations to come after the next generation. In the middle of the screen, the options for the current and next generations are presented next to the white and striped icons, respectively.

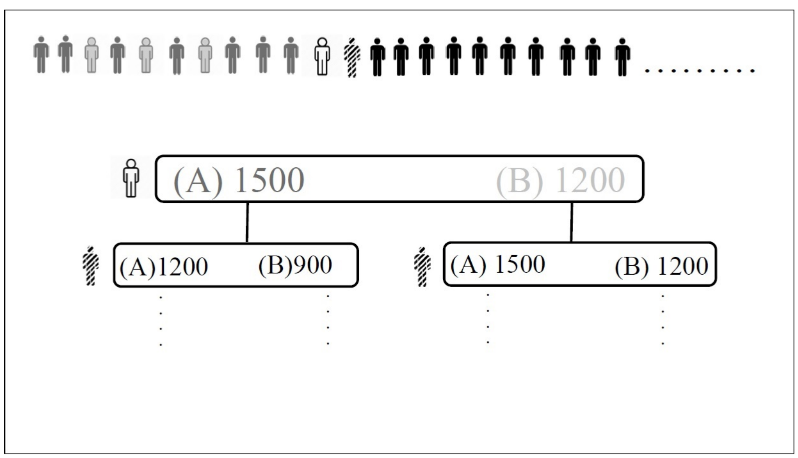
In addition to these 35 situations of the one-person ISDG, each subject plays one binding situation whose decision environments evolve over generations according to how previous generations have chosen and how the current generation chooses, being passed to the subsequent generations within the sequence to determine the real payment to subjects. In the binding situation, the 1st generation starts the

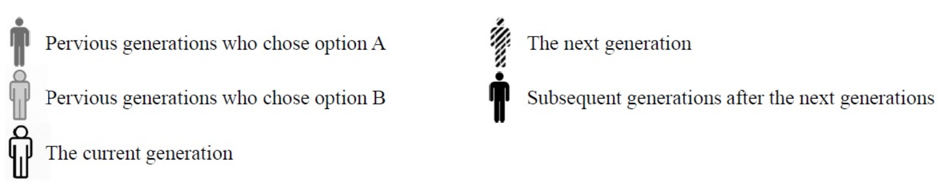
Figure 3.2: The 23rd situation of the one-person ISDG as seen by each subject

(a) The first screen



(b) The second screen





game with option $A = 3600$, where one value of D is randomly picked from the four possible values of 300, 600, 900 and 1200. Once it is picked, the value of D remains the same for the $1\text{st}, 2\text{nd}, \ldots$ generations in the sequence for the binding situation. The binding situation is continued as long as the value of X is strictly positive and ends when it becomes zero or negative for some generation in the sequence. Therefore, the payoff structures in the decision environment faced by each generation in the sequence for the binding situation are different, while the 35 situations in table 3.1 are uniformly played by all subjects. We call a series of the benchmark experimental procedures in which each subject plays the 36 situations "basic ISDG treatment."

Building upon the basic ISDG treatment, we apply the future ahead and back (FAB) mechanism for the one-person ISDG in 36 situations, which is hereafter called the "FAB treatment." In the FAB treatment, we ask each subject to go through the following steps in each situation. As the 1st step, each subject is asked to imagine that she is in the next generation. From the standpoint of the next generation, she is asked to make a request about the choice that she wants the previous generation to choose between options A and B. As the 2nd step, the subject is asked to return to her original (actual) position in the sequence, and she makes her final and actual decision by choosing one option, A or B, for that situation. For instance, if a subject is the 5th generation in the sequence for one situation, then she is asked to imagine herself in the position of the 6th generation in the sequence and to make a request about the choice that she wants the 5th generation in the sequence to make. After that, she is asked to return to her original position in the sequence (i.e., the 5th generation) and make her final and actual choice for that situation.

Each subject was randomly assigned to either the basic ISDG treatment or the FAB treatment and played the one-person ISDG with a strategy method in 36 different situations, consisting of the 35 fictional situations and a single binding situation. The orders of the 36 situations that each subject went through in the one-person ISDG were randomly shuffled to avoid order effects. The experimenters offered the following explanation to the subjects: "One situation out of the 36 situations shall be chosen for the actual experimental payment, following a certain rule. Because you do not know in advance which situation shall be chosen for the payment, please be serious and considerate about a choice in each situation that may affect the subsequent subjects, because they will play after you." However, in reality, to simplify the experimental procedures, the experimenters predetermined that the choices and outcomes in the binding situation would only be used to determine the experimental payment of each subject and to affect the subsequent subjects. In the one-person ISDG, one experimental token was calculated and exchanged as 1.5 JPY, and subjects were paid 3000 JPY (≈ 27.8 USD) on average.

3.2.2 Social value orientation

Subjects' social preferences are proxied by their social value orientations (SVOs), which were identified using the triple dominance measure (Van Lange et al., 1997). This measure consists of 9 items, each of which contains three choices. For each item, subjects must make one choice over how to divide an amount of money between herself and a stranger. For example, each subject faces the following three options: A: you get 500 and the other gets 100, B: you get 500 and the other gets 500 and C: you get 560 and the other gets 330. A competitive subject is likely to choose option A, maximizing the gap between her own and the stranger's points $(500 - 100 = 400)$. A prosocial subject has high chances of choosing option B, as it maximizes the joint benefit $(500 + 500 = 1000)$. An individualistic subject chooses option C by maximizing her payoff without considering the other (Van Lange et al., 2007). A subject's type, i.e., individualistic, competitive or prosocial, is identified by her choices in the SVO game. When a subject makes 6 consistent choice for the same orientation (i.e., individualistic, competitive or prosocial) out of the 9 items, then she is considered to have that orientation or otherwise is "unidentified." Subjects were randomly paired for the computation of their payoffs based on their performance, and they were paid on average 500 JPY (≈ 4.7 USD) in the SVO game.

3.2.3 Experimental procedures

Our experiments were conducted at experimental laboratories at Kochi University of Technology. The experiment comprised 27 sessions, each involving $4 \sim 5$ subjects, for a total of 104 subjects (55 females and 49 males; average age $= 20.4$). The observations of 6 subjects in the FAB treatment and

1 subjects in the basic ISDG treatment were dropped because of missing responses in the one-person ISDG, which made the number of subjects in the FAB treatment lower than that in the basic ISDG treatment. The subjects were volunteer undergraduate students in various fields such as engineering and social science; each subject participated in only one session and was paid in total 4000 JPY (≈ 37 USD) on average. The time of each session varied between the basic ISDG and FAB treatments. One session in the basic ISDG treatment consisted of two parts and took approximately 75 minutes. In the first part, subjects completed the one-person ISDG for 40 minutes. In the second part, they completed the SVO game and questionnaires for 35 minutes. One session in the FAB treatment also consisted of two parts and took approximately 90 minutes. In the first part, subjects completed the one-person ISDG for 55 minutes—a longer duration than that of the basic ISDG treatment due to the additional procedures in the FAB (see the 1st and 2nd steps of the FAB treatment within the dashed-line box in figure 3.3). In the second part, they complete the SVO game and questionnaires for 35 minutes.

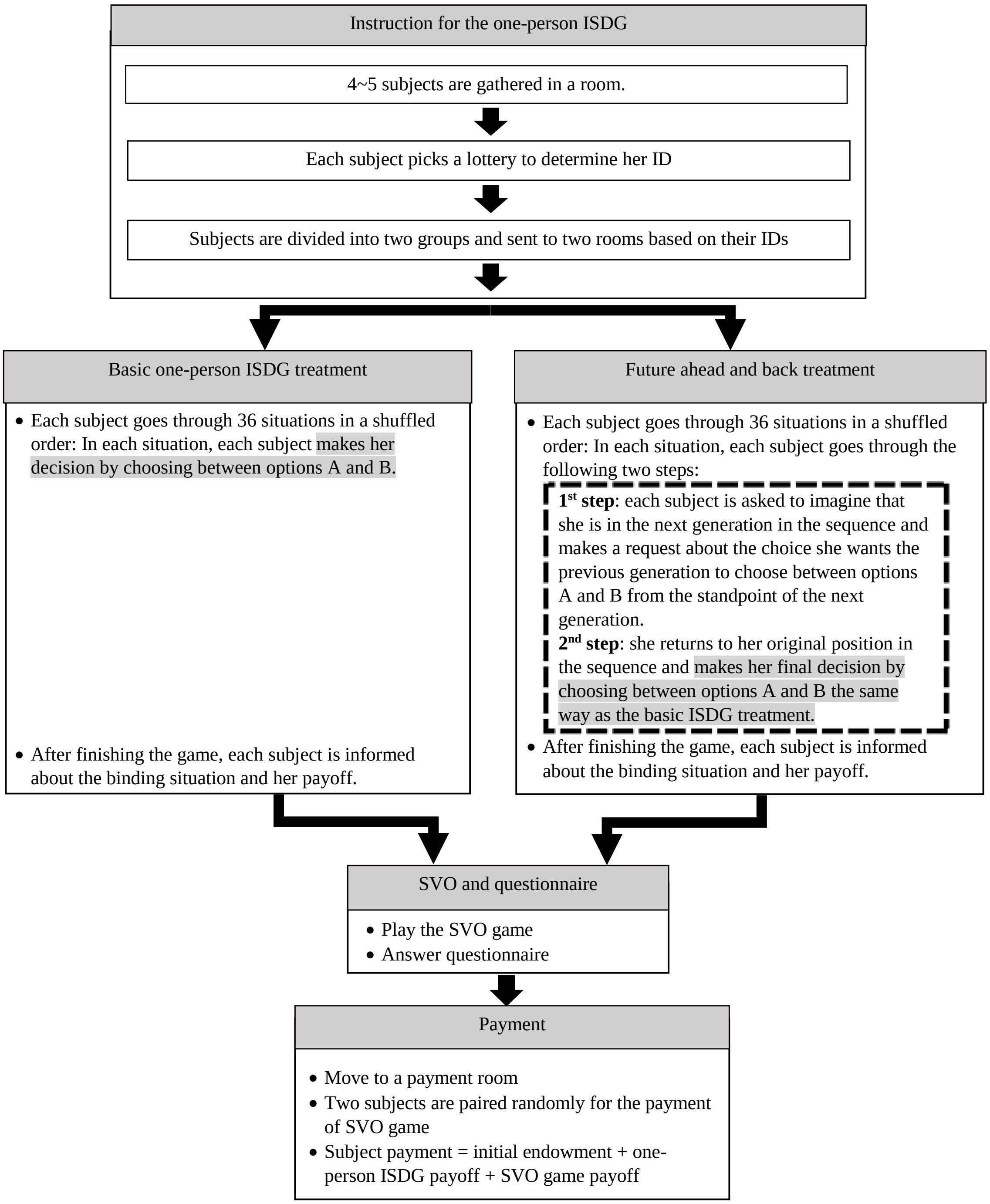
Figure 3.3 presents a flow chart for the procedures of the one-person ISDG, SVO game and questionnaire in one session for the basic ISDG and FAB treatments. Upon arriving to the meeting room, each subject picked a lottery number that determined her experimental ID. Then, the subjects were taken to two different designated rooms based on their experimental IDs. In the basic ISDG treatment, each subject read the experimental instructions and listened to an oral presentation made by an experimenter about the basic one-person ISDG. We use neutral terminologies in the explanations and avoid using terms such as "generations," "sustainable" and "unsustainable." Then, each subject completed the 36 situations of the basic one-person ISDG treatment in a shuffled order. Each subject made her decision by choosing between options A and B in each of the situations. When a subject finished making the decisions in all 36 situations, she was informed of the situation number that corresponded to the binding situation, which determined her final payoff from the one-person ISDG. Then, subjects moved to a different room to complete the SVO game and fill out the questionnaires. After that, the subjects moved to a payment room, where the payment for the SVO game was calculated by randomly pairing subjects together. In the FAB treatment, each subject follow the same steps of basic ISDG treatment in addition to a perspective-taking step as follows. In each situation, the subject was asked to imagine that she was in the position of the next generation in the sequence. From that position, she made a request to the previous generation on which choice she wanted the previous generation to make. After that, she returned to her original position in the sequence and made her final decision between options A and B.

3.2.4 Screen of one-person ISDG game

Figure 3.4(a) shows the screens that a subject observes while playing the basic ISDG and FAB treatments. The screens for the basic ISDG treatment are displayed and two screens presented in each situation. The first screen presents the situation number and appears for 3 seconds. After that, the second screen appears for 15 seconds and presents the history of the previous generations' choices at the top of the screen and the options available for the current and subsequent generations in the middle. We call the second screen the "one-person ISDG screen." During the time in which the second screen is displayed, each subject makes her decision by entering the character "A" or "B" in another computer display served as a response device. A subject has to go through the above processes by observing the first and second screens in each situation, and the one-person ISDG is continued until she finishes making the decisions in all 36 situations.

Figure 3.4(b) presents a series of screens that a subject faces for each situation under the FAB treatment in the one-person ISDG. The first screen presents the situation number for 3 seconds. The second screen is the same screen as the second screen in the basic ISDG treatment (i.e., the one-person ISDG screen), which is displayed for 4 seconds to familiarize subjects with the decision environment. The third screen is displayed to notify the subject that she should imagine herself in the position of the next generation in the sequence and make a request about which choice she wants the previous generation to make between options A and B. Then, the one-person ISDG screen is displayed again for 10 seconds. At that time, the subject must make a request of the previous generation by entering the character "A" or "B" in another computer display served as a response device. After that, another notice screen appears for 3 seconds to let the subject know that she must return to her original position. The one-person ISDG screen appears one more time for 10 seconds to present the one-person ISDG choices

Figure 3.3: Procedures of the one-person ISDG, SVO game and questionnaire in one session



to the subject, and she makes her final choice from her original position in the current generation. Subjects make their final choice by entering “A” or “B” in the response device, while the request they have made as the next generation kept visible on the display of the response devise. As in the basic ISDG treatment, a subject has to go through the above processes by observing a series of screens in each situation, and the one-person ISDG is continued until she finishes making the decisions in all 36 situations.

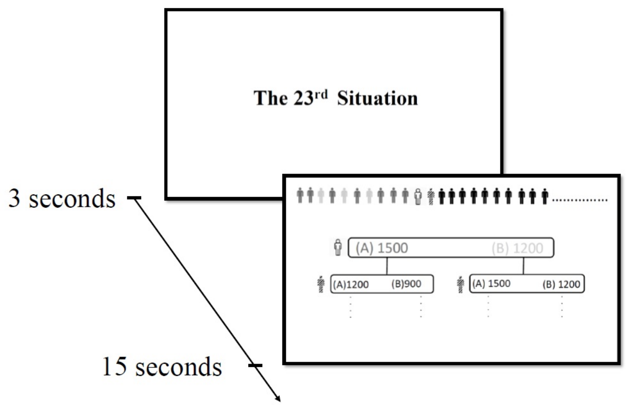
3.3 Results

Table 3.4 presents the summary statistics of experimental results for the basic one-person ISDG (basic ISDG) and the future ahead and back (FAB) treatments. The number of subjects who participated in the basic ISDG and FAB treatments is 55 and 42 subjects, among which the number of prosocial subjects are 30 and 14, respectively. Each subject went through the 36 situations of the one-person ISDG in both treatments, generating a total number of observations of 1980 ($= 55 \times 36$) and 1512 ($= 42 \times 36$) in the basic ISDG and the FAB treatment, respectively. Approximately 33.7 % and 44.5 % of the generational choices are option B in the basic ISDG and FAB treatments, implying that the percentages choosing option A are 66.3 % and 55.5 %, respectively. These results appear to suggest that the FAB treatment is effective at inducing subjects to choose the sustainable option. To statistically confirm the difference, we run a chi-square test with the null hypothesis that the frequencies of the observations of subjects choosing options A and B between the basic ISDG and the FAB treatments are the same, and the null hypothesis is rejected at the 1 % significance level ($\chi^2 = 42.4$, $P < 0.01$).

Figure 3.5(a) shows the frequency distributions of the percentage per subject of the choice of option B in the 36 situations under the basic ISDG and FAB treatments; the percentage represents the number of situations in which the subject chooses option B divided by 36 (one subject goes through 36 situations and is asked to choose between options A and B in each situation). Figure 3.5(a) demonstrates that the distribution under the basic ISDG treatment is skewed to the left, as the peak of the distribution is around 0 % to 10 %, indicating that a considerable portion of subjects do not choose option B at all

Figure 3.4: The screen of the ISDGs as seen by each subject in chronological order

(a) One-person ISDG situation for the basic ISDG treatment



(b) One-person ISDG situation for the FAB treatment

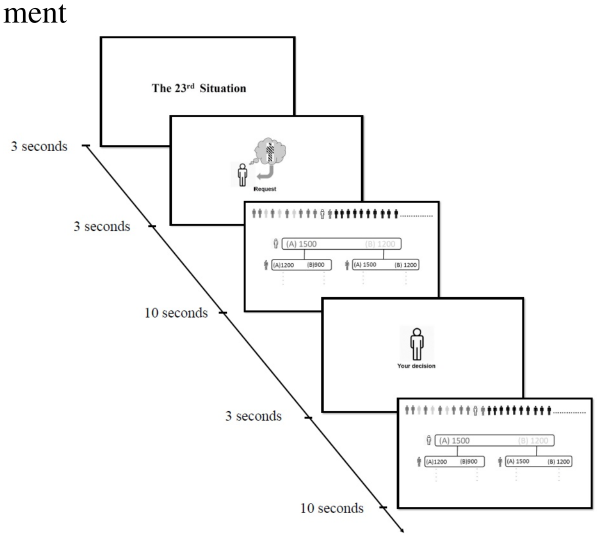


Table 3.4: Summary statistics

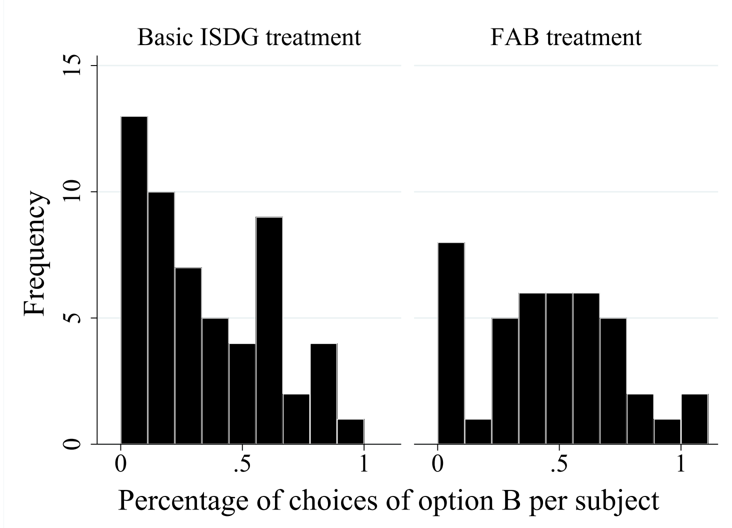
	Basic ISDG treatment	FAB treatment
Total no. of subjects	55	42
No. of prosocial subjects	30 (55 %)	14 (33 %)
No. of proself subjects	25 (45 %)	28 (67 %)
No. of situations per subject	36	36
Total no. of observations	1980	1512
Observations of choosing option A	1313 (66.3 %)	839 (55.5 %)
Observations of choosing option B	667 (33.7 %)	673 (44.5 %)

or only around 10 % of the time. On the other hand, the distribution under the FAB treatment is flattened, with more concentration of around 50 % as well as a reduction in the peak's height at 0 %. We also draw the corresponding boxplots in figure 3.5(b) for the same distributions under the basic ISDG and FAB treatments, corroborating that the location parameters, such as medians and quantiles, for the percentage of choices of option B per subject in the FAB treatment are generally higher than those in the basic ISDG. We also run a Mann-Whitney test with the null hypothesis that the distributions of the percentage of choices of option B per subject between the basic ISDG and FAB treatments are the same. The null hypothesis is rejected at the 10 % significance level ($z = -1.79, P = 0.072$), implying that subjects are more likely to choose option B in the FAB treatment than in the basic ISDG treatment.

Table 3.5 displays the percentages of choices of option B for prosocial and proself subjects in each of the basic ISDG and FAB treatments by pooling observations from subjects. The percentages of choices of option B made by prosocial subjects under the basic ISDG and FAB treatments (44.72 % and 55.56 %) are higher than those made by proself subjects (20.44 % and 38.99 %). The result suggests that prosocial subjects tend to choose option B more than proself subjects, which is consistent with the literature (Gintis et al., 2003; Camerer and Fehr, 2006). At the same time, the percentages of choices of option B made by prosocial and proself subjects under the FAB treatments (55.56 % and 38.99) are higher than those under the basic ISDG treatment (44.72 % and 20.44 %). We run a chi-square test with the null hypothesis that the frequency distributions of choosing option B among prosocial and proself subjects are the same between the basic ISDG and FAB treatments. The result rejects the null

Figure 3.5: The distribution of option B choices percentage per subject in the basic ISDG and FAB treatments

(a) Frequency distribution of option B choices percentage per subject in the basic ISDG and FAB treatments



(b) Boxplot of option B choices percentage per subject in the basic ISDG and FAB treatments

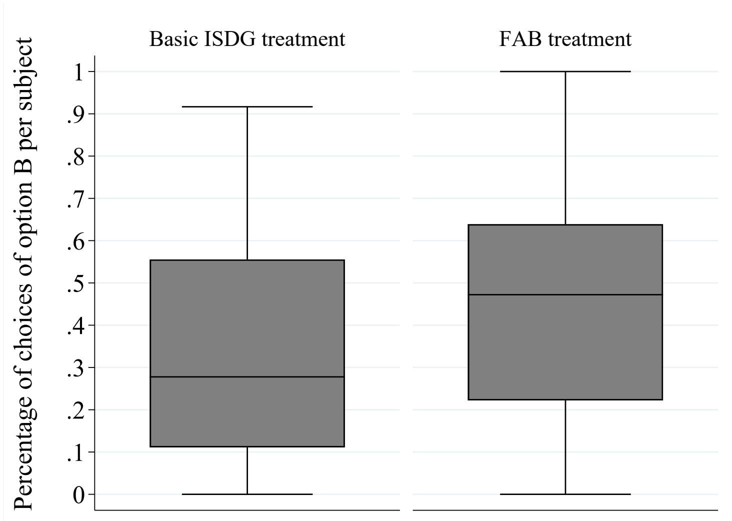


Table 3.5: The percentages of option B for prosocial and proself subjects in the basic ISDG and FAB treatments

	Percentages of option B choices		
	Basic ISDG treatment	FAB treatment	Overall
Prosocial	44.72 % ($\approx\frac{483}{1080}$)	55.56 % ($\approx\frac{280}{504}$)	48.17 % ($\approx\frac{763}{1584}$)
Proself	20.44 % ($\approx\frac{184}{900}$)	38.99 % ($\approx\frac{393}{1008}$)	30.24 % ($\approx\frac{577}{1908}$)
Subtotal	33.69 % ($\approx\frac{667}{1980}$)	44.51 % ($\approx\frac{673}{1512}$)	38.37 % ($\approx\frac{1340}{3492}$)

hypothesis at the 1 % level ($\chi^2 = 129.6, P < 0.01$), demonstrating that the FAB treatment appears to be effective at inducing subjects to choose option B, irrespective of subjects' value orientations.

To quantitatively characterize the marginal impact of subjects' SVO and the prospective and retrospective factors on subjects' choices in the one-person ISDG, panel logit regressions are applied to our experimental data. In the regressions, a dummy variable capturing the subject's binary choice between options A and B in each situation is specified as the dependent variable, taking a choice for option A as the base group. On the other hand, the SVO, the percentage of option A in the sequence history, FAB treatment & the IS index ($\frac{X}{D}$) in each situation and the interaction terms of these variables are specified as the independent variables. Since one subject provides 36 observations in our experiment, the data are considered to possess a panel-data structure, where a panel unit is a subject and a time unit is one situation out of the 36. Since a time-invariant independent variable (the SVO) is included as one of the independent variables in the analysis, we apply a random-effects panel logit regression (Wooldridge, 2010, 2019). With these model specifications, we not only estimate the model but also calculate the marginal effect of an independent variable on the likelihood of a subject choosing option B (Wooldridge, 2010). Table 3.6 summarizes the estimation results and the associated marginal probabilities from the three panel logit regressions.

In model 1 of table 3.6, we consider the basic independent variables, consisting of the prosocial dummy, the percentage of option A choices in the sequence history, the FAB treatment dummy and the IS index, finding that all the coefficients and marginal probabilities of these variables are statistically significant at 1 % level. All the independent variables have a positive relationship with the probability of choosing option B except the percentage of option A choices in the sequence history. More specifically, subjects in the FAB treatment (prosocial subjects) are 15.8 % (22.4 %) more likely to choose option B than those in the basic ISDG treatment (proself subjects), while an increase of one unit in the IS index leads subjects to choose option B more often by 0.2 %. On the other hand, subjects are 0.97 % less likely to choose option B as the percentage of option A choices in the sequence history increases by 10 %. These results indicate that prosociality and the FAB treatment are effective at maintaining IS, which is in line with previous studies on group behaviors. For example, Hauser et al. (2014) indicate that a group tends to be sustainable when a majority are prosocial individuals, while Kamijo et al. (2017); Shahrier et al. (2017c) and Timilsina et al. (2019a) show that the introduction of some mechanisms can have positive effects on group behaviors for IS.

In models 2 and 3, we include interaction terms for the FAB treatment dummy & IS index and the FAB treatment dummy & the percentage of option A choices in the sequence history. The estimation results remain qualitatively the same as those in model 1, while the interaction term of the FAB treatment dummy & IS index (FAB treatment dummy & percentage of option A choices in history) is statistically significant at the 1 % level (insignificant) with a negative sign in models 2 and 3 (in model 3). The results suggest that subjects behave differently under the basic ISDG and FAB treatments in response to the IS index, while they do not respond to the percentage of option A choices in the sequence history. Specifically, subjects tend to choose option A as the IS index decreases, reflecting the result of model 1 in table 3.6. However, the results associated with the interaction terms in models 2 and 3 suggest that the FAB treatment prevents subjects from choosing option A in response to a decrease in the IS index, making the treatment effective as sustainability becomes endangered. We apply several other models including different specifications and other interaction terms as robustness checks, yielding qualitatively similar results to those in models $1, 2$ and 3 of table 3.6.

To quantitatively demonstrate how subjects behave differently under the basic ISDG and FAB treatments, we calculate the predicted probabilities of a subject choosing option B over the IS index in each treatment based on the estimation result of model 2 in table 3.6. The predicted probabilities are calculated by changing the IS index, holding other independent variables fixed at the sample means.

Table 3.6: Panel logit models with a dummy variable of the binary choice between options A and B as the dependent variable, where the choice of option A is the base group

	Model 1		Model 2		Model 3	
	Coefficients	Marginal effects[1]	Coefficients	Marginal effects	Coefficients	Marginal effects
Prosocial[2]	1.42^{***}	0.224^{***}	1.431^{***}	0.225^{***}	1.431^{***}	0.225^{***}
	(0.369)	(0.058)	(0.371)	(0.058)	(0.371)	(0.058)
% of option A in history[3]	-0.615^{***}	-0.097^{***}	-0.602^{***}	-0.095^{***}	-0.599^{***}	-0.095^{***}
	(0.131)	(0.021)	(0.131)	(0.021)	(0.175)	(0.021)
FAB treatment[4]	1.001^{***}	0.158^{***}	1.337^{***}	0.159^{***}	1.341^{***}	0.159^{***}
	(0.370)	(0.059)	(0.381)	(0.058)	(0.405)	(0.058)
IS index $\left(\frac{X}{D}\right)^5$	0.014^{***}	0.002^{***}	0.028^{***}	0.002^{***}	0.028^{***}	0.002^{***}
	(0.003)	(0.0006)	(0.005)	(0.0006)	(0.005)	(0.0006)
FAB $\times$ IS index			-0.032^{***}	-	-0.032^{***}	-
			(0.008)	-	(0.008)	-
FAB $\times$ % of option A in history					-0.007	-
					(0.265)	-
Observations	3492		3492		3492	
Wald χ^2	51.98^{***}		68.43^{***}		68.44^{***}	

***, **, * significant at the 1 %, 5 % and 10 % levels, respectively.
Standard errors in parentheses.

[1] Calculated at the same means of the independent variables.

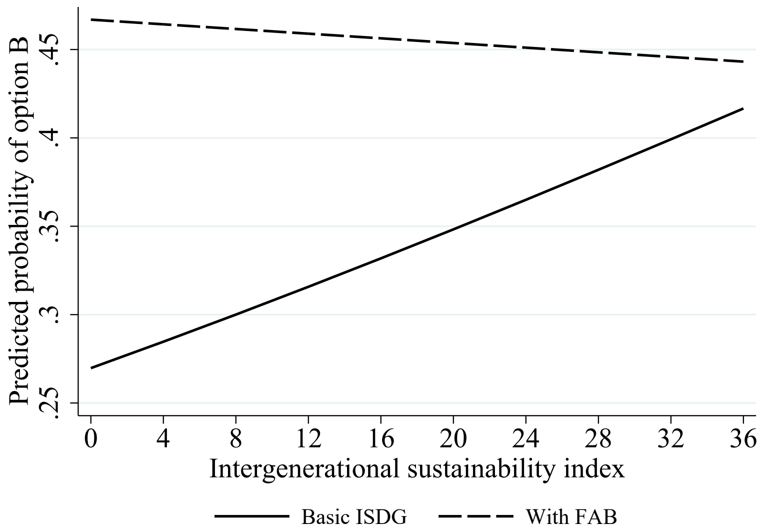
[2] Prosocial is a dummy variable for SVO, taking 1 if the subject is categorized as prosocial and 0 otherwise.

[3] % of choice A in history is the percentage of option A choices in the sequence history, taking a value from 0 to 1 reflecting the ratio of the number of previous generations that chose option A to the total number of previous generations in the sequence history for each situation.

[4] FAB treatment is a dummy variable taking 1 if the subject is in the FAB treatment and 0 otherwise.

[5] IS index is an ordered categorical variable for the ratio of $\frac{X}{D}$, taking a value from 0 to 36.

Figure 3.6: Predicted probability of choosing option B for subjects in the basic ISDG and FAB treatments

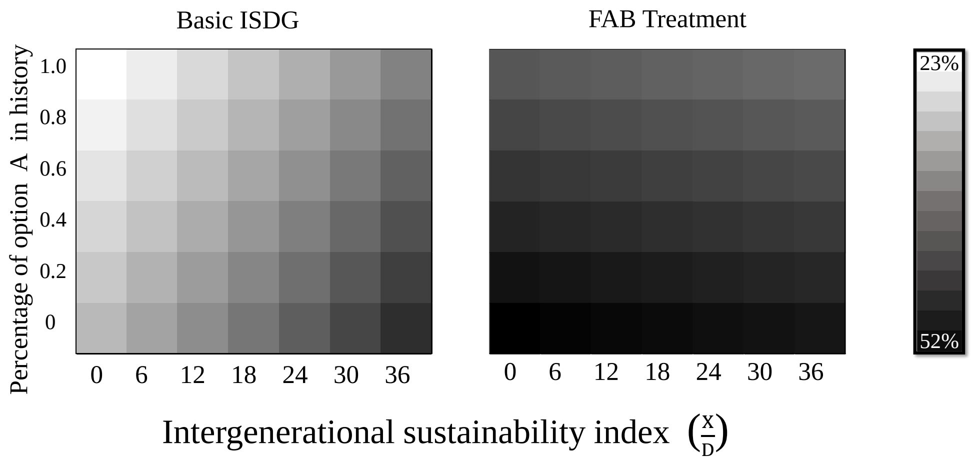


Because the interaction term of the FAB treatment dummy & IS index is estimated to be negative in model 2, the predicted probabilities under the FAB treatment should be larger than those under the basic ISDG treatment as the IS index decreases. Figure 3.6 displays the predicted probabilities over the IS index under basic ISDG and FAB treatments represented by the solid and dashed lines, respectively. As seen in figure 3.6, the trajectories over the IS index are clearly different between the basic ISDG and FAB treatments. The predicted probability under the basic ISDG (solid line) increases in the IS index ranging from 0.27 to 0.41, while that under FAB (dashed line) is almost flat or only slightly decreases in the IS index ranging from 0.47 to 0.44. These results in figure 3.6 confirm that subjects tend to choose option A under the basic ISDG when the IS index of a prospective factor is low. However, the introduction of the FAB can induce subjects to consistently or stably choose option B irrespective of the values of the IS index.

Next, we characterize how subjects respond to the retrospective and prospective factors in the ISD within a single framework. To this end, two heat maps are drawn to present the predicted probabilities of choosing option B under the basic ISDG and FAB treatments on the domain of the percentage of option A choices in the sequence history and the IS index (figure 3.7). The predicted probabilities are calculated based on the estimation results in model 3 of table 3.6. The predicted probabilities are calculated in the same way as in figure 3.6 by holding other independent variables fixed at the sample means. In addition, as a robustness check, they are calculated based on the estimation results in model 2. We confirm that they remain qualitatively the same as in figure 3.7. The vertical (horizontal) axis represents the percentage of option A choice in the sequence history (IS index), and it varies from 0 to 1 (from 0 to 36). The density of the black color in each location of the domain reflects the predicted probability of choosing option B; the darker the color, the higher is the predicted probability. The scale, ranging from 23 % to 52 %, is shown on the right-hand side in figure 3.7.

The predicted probabilities under the basic ISDG in figure 3.7 corroborate that subjects are more likely to choose option A as the IS index (the percentage of option A in history) becomes lower (higher), consistent with the results in table 3.6 and figure 3.6. This is quite intuitive in the sense that people in the current generation tend to give up being sustainable when previous generations chose such unsustainable options that it may be too late or the situation faced by the current generation too grave for sustainability to be improved. However, the predicted probabilities under the FAB treatment in figure 3.7 show that subjects tend to choose option B stably and consistently, being more invariant against changes in either the IS index or the percentage of option A in history than the probabilities in the basic ISDG. In fact, the predicted probabilities under the FAB treatment range from 40 % to 52 %, demonstrating that asking subjects to take the position of the next generation fundamentally affects their choices between options A and B in response to the retrospective and prospective factors in the ISD. Overall, the regression results in table 3.6, figures 3.6 and 3.7 establish that people react to the retrospective and prospective factors in an intuitive way under the basic ISDG, implying that people in the current generation choose unsustainability if previous generations betray them and it seems too late for the current situation to be made sustainable. However, the FAB treatment is demonstrated to prevent people from making such choices.

Figure 3.7: Heat map of the predicted probability for option B choice on the domain of option A choices' percentage in the sequence history and $\frac{X}{D}$



3.4 Discussion

Some behavioral scientists and economists have recently emphasized the importance of analyzing economic, cognitive and noncognitive factors to characterize human behaviors at the individual and group levels in a single framework (Borghans et al., 2008; Izuma et al., 2010; Lindqvist and Vestman, 2011; Acharya et al., 2018; Chen et al., 2019). Our experiments are considered to systematically examine individual behaviors in response to these factors under the ISD in the sense that prospective and retrospective factors and social preferences are known to correspond to economic and noncognitive factors, respectively (Borghans et al., 2008). Overall, the results are interpreted to demonstrate that the economic factors of the IS index and the percentage of option A choices in the sequence history as well as social preferences have impacts on individual behaviors in the ISD in an intuitive way, consistent with the literature on the dictator and other games. In particular, a social preference of prosociality is identified as one influential factor in subjects choosing the sustainable option in the ISDG, and a similar result is consistently confirmed in common pool resource and public goods games (Hauser et al., 2014; Kamijo et al., 2017; Shahrier et al., 2017c; Timilsina et al., 2017). However, people's social preferences are claimed to be determined at young ages by the culture and social norms of societies, remaining fixed when they become adults. Therefore, these preferences are considered impossible to change with policy or external interventions (Ockenfels and Weimann, 1999; Koch et al., 2011; Carlsson et al., 2014).

An important question here is why and how the FAB mechanism affects individual behaviors in the ISD. Although we admit that there are several possible explanations, we conjecture that the FAB mechanism affects a cognitive factor in human-decision processes (Konow, 2000). In particular, Cooper (2007) argues that some dissonance in human cognition, that is, cognitive dissonance, may influence human decisions when individuals experience two or more different psychological and/or economic representations in a decision-making situation, such as a social dilemma where two representations conflict with one another regarding interests and payoffs. Since the FAB mechanism requires each individual to experience or role-play two representations of the current and future generations where each generation's interest conflicts, we argue that cognitive dissonance in subjects' decision-making processes might have been triggered and augmented to enhance sustainable choices over the outcomes observed in the basic ISDG.

Another possible explanation is that the FAB mechanism might affect not only cognitive factors but also noncognitive factors in human decision-making processes. Some economists, psychologists and neuroscientists demonstrate that empathy is a primary factor in characterizing prosocial behaviors in several different games and settings and is known to play a part in cognitive and noncognitive factors (Batson et al., 1988; Snow, 2000; de Vignemont and Singer, 2006; Decety and Ickes, 2009; Mathur et al., 2010; Tusche et al., 2016). In economics, Andreoni and Rao (2011) and Andreoni et al. (2017) demonstrate that prosocial donations are increased in the DG by letting one subject role-play both the dictator and the receiver. They argue that empathy from the dictator to the receiver is enhanced by such role-playing and is a key means of promoting prosocial behaviors. Furthermore, psychologists argue that empathy can be a main factor in a person making decisions to the benefit of others or engaging in prosocial behaviors even at a personal cost (Batson et al., 1988). In the ISDG, choosing the sustainable option is equivalent to benefiting others at a personal cost. Thus, the FAB mechanism may be considered to enhance the empathy of the current generation through its role-playing of the next generation in the ISD.

Democracy and capitalism have become two major social institutions that have been adopted by many countries in the world over the last few decades. However, some social scientists argue that these institutions are not future-oriented but present-oriented in their nature (Wolf, 2008; Saunders, 2014). The decision-making processes under democracy and capitalism rarely require people to take the standpoint of future generations, even for intergenerational problems such as climate change and government debt, and the decisions end up being mostly made from the current generation's standpoint (Milinski et al., 2006; Ekeli, 2009; Christiano, 2010; Mulgan, 2011; Steffen et al., 2015; Hansen and İmrohoroğlu, 2016; Steffen et al., 2018). Our findings imply that IS problems will worsen in the absence of a new mechanism to affect people's cognitive and/or noncognitive processes. They also suggest that the FAB mechanism is one approach to nudge the current generation toward being more future-oriented by asking her to role-play future generations and send a request to the current generation. We believe that institutionalization of the FAB mechanism is one possible resolution of the ISD, affecting people's cognitive and noncognitive factors by propagating an idea of "putting oneself in future generations' shoes" at the individual, household and society levels. Introducing the FAB mechanism will be more likely to lead to better outcomes for sustainability than introducing nothing.

3.5 Conclusion

This paper has addressed the intergenerational sustainability dilemma (ISD) and how individuals behave under the ISD. We hypothesize that the economic factor (the prospective factor, i.e., the IS index) and histories of previous generations' behaviors (i.e., the retrospective factor) affect the decisions made by the current generation that impact herself and future generations in the ISD. To examine the hypothesis, a basic one-person ISD game (ISDG) treatment was designed and implemented with a strategy method in a laboratory experiment. In addition, the future ahead and back (FAB) mechanism was instituted as a possible solution for the ISD. The experimental results in the basic ISDG treatment show that people are more likely to choose the unsustainable option as sustainability is increasingly endangered (i.e., the IS index is low and/or the percentage of previous generations that chose the unsustainable option is high). In other words, people are said to react to retrospective and prospective factors in an intuitive way, in that no one chooses to be sustainable after previous generations have betrayed the current generation or if it appears too late to do anything about the current situation. On the other hand, the FAB mechanism is identified to positively influence individual behaviors for maintaining sustainability even in such an endangered situation. We argue that a possible explanation for the effectiveness of the FAB mechanism is an increase in cognitive dissonance and/or the associated empathy toward future generations.

Chapter 4

Do disasters matter? What characterize instability of public health allocations

4.1 Introduction

The key to the wellbeing of a country's population is the availability of accessible and proper health services. At least half of the world population still can not obtain essential health services, where these families are pushed to poverty because they have to pay for health costs out of their own pockets (WHO and WB, 2017). Universal health coverage could be a proper solution for such a problem by providing standardized high quality health services to all countries' citizens. The government should provide proper budgetary allocations for the health sector among other different sectors. The allocations of the governmental budgets evolve through incremental adjustments due to time and information constraints for policymakers (Lindblom, 1959; Wildavsky, 1964; Davis et al., 1966). However, sometimes the media coverage for some news or incidents in a country can make the policymakers departure from the status quo, leading to governmental allocation instability (Jones and Baumgartner, 2005). This instability is described by punctuated equilibrium theory, i.e., PET (Guragain and Lim, 2019). Like other governmental allocations, public health allocations might face instability due to the media coverage for health related news such as health disasters or pandemics. This budgetary health allocation instability has a negative effect on the long-term growth of such allocations, affecting the quality of health services (Breunig, 2012). Therefore, it is important to understand determinants of public health allocation instability.

Policymaking is a continuous struggle between different political powers to achieve equilibrium governed by positive and negative feedback processes (Baumgartner et al., 2002). PET is a theoretical framework that most political scientists use to explain policy or budgetary processes instability. PET describes a long period of stability disjointed by the abrupt policy or budgetary change (Jones and

Baumgartner, 2012). Humans' limited cognitive abilities allow them to focus only on few specific issues, ignoring other indefinite ones. Thus, policymakers do not pay attention to some issues for a long period and these neglected issues worsen to the point that the media starts to focus on them, leading to an overreaction from policymakers to address them and make significant changes in a policy (Jones and Baumgartner, 2012; Guragain and Lim, 2018). Ryu (2009) and Jones and Baumgartner (2012) indicate that another responsible factor for major changes (i.e., punctuation) in the policy is the institutional fractions and breaches in the policy status quo as a result of accumulating pressure in a political system. Overall, PET shows institutional fractions and availability of information about some issues for policymakers are the main causes of the instability and punctuation in budget allocations.

Some researchers use cross-sectional data to study the fluctuations of governmental budgetary allocations among different sectors utilizing PET as a theoretical framework. Breunig (2006) examines budget instability in Denmark, Germany, the United Kingdom, and the United States, finding that the changes in budgets are incremental with some punctuations in allocations over time in these countries due to political and institutional constraints. Ryu (2009) explores factors that cause budget stability and punctuation in the United States, showing that fractions in institutions and information availability increase punctuations in budgets. Sebők and Berki (2018) analyze Hungarian budgeting between 1868 and 2013, indicating that the change in the regime from autocracy to democracy reduces the occurrence of punctuation in the governmental budgets. In short, previous research has shown that institutional frictions and political constraints are determinants of punctuation occurrence in governmental allocations.

Other scholars examine the factors that affect public health allocations on national and regional levels using panel data. Bellido et al. (2018) study the government's ideology and its effect on public healthcare expenditures in Organization for Economic Cooperation and Development countries. They show that left-wing governments tend to allocate a high percentage of the budget to the health sector compared to other governments with different ideologies. Behera and Dash (2019) explore relationships between public health allocations and fiscal space (i.e., fiscal transfer, tax revenue, non-tax revenue and debts) in 21 states of India from 1980 to 2014. They identify that governmental debts have a negative effect on public health allocations. Bettin and Sacchi (2020) study immigration effect on public health allocations for different regions in Italy from 2003 to 2016. They show that the increase in the number of young and healthy immigrants leads to a decrease in per capita public health allocations. Previous researches indicate that government debt and immigrants (left-wing governments) have a negative (positive) impact on public health allocations.

Past studies identify the factors that influence public health allocations and use PET as a theoretical framework to examine the changes in governmental budgetary allocations. There is little research that examines determinants of public health allocation instability on the international level using PET. This chapter uses PET to explore the determinants of public health allocation instability, hypothesizing that disasters are the main factor affecting such allocations. To test this hypothesis, panel data of 191 countries from 1995 to 2014 about disasters, economic development, governance and public health allocations are collected and analyzed. This research novelty lies in exploring the effects of external factors (i.e., health and natural disasters) on public health allocation instability while controlling internal factors (i.e., governance and economic factors) in a single analytical framework.

4.2 Methods and materials

4.2.1 Data and theoretical framework

This research uses data of 191 countries from 1995 to 2014 using the Emergency Event Database (EM-DAT), World Development Indicators, Global Health Observatory, Worldwide Governance Indicators and Historical Public Debt to examine the factors that influence public health allocations instability (Guha-Sapir et al., 2015; WB, 2016; WHO, 2017; Kaufmann and Kraay, 2019; IMF, 2020). Data are collected about general government expenditure on health as a percentage of total government expenditure (hereafter, public health allocations) from the World Health Organization (WHO, 2017). We examine public health allocations instability over time by analyzing the annual percentage change of public health allocations. The percentage change in the public health allocations is determined as follows:

$$\%\Delta H_t = \frac{H_t - H_{t-1}}{H_{t-1}} \times 100 \tag{4.1}$$

where $\%\Delta H_t$ is the percentage change in the current year public health allocations compared with the previous year's allocation, H_t is the value of the current year's public health allocations, and H_{t-1} is the value of the previous year's public health allocation. Public health allocation instability is conceptualized as punctuation using punctuated equilibrium theoretical (PET) framework. Punctuation refers to sudden and big fluctuations of an increase with more than 35 % ($\%\Delta H_t > 35$ i.e., positive punctuation) or a decrease with more than 25 % ($\%\Delta H_t < -25$ i.e., negative punctuation) in the percent change of the current year public health allocation (Jordan, 2003; Breunig, 2006).

The paper applies panel logistic regressions to explore the determinants of public health allocation instability. We run three models taking punctuation, positive and negative punctuations as dependent variables in each model and last year's punctuation, disasters, population, GDP, governmental debt, economic development of countries, governance indicators and some interaction terms as independent variables in all models. EM-DAT database reports a disaster when one of the following conditions is met: a death of ten or more people is reported, an injury of hundred or more people is reported, a declaration of the state of emergency and a call for international assistance (Guha-Sapir et al., 2015). We distinguish between natural and health disasters in this paper because natural disasters such as earthquakes, tsunamis and landslides might affect other public sectors' allocations besides the health sector. On the other hand, health disasters are directly related to health sector allocations referring to epidemics or pandemics such as Ebola and COVID-19. The number of deaths determines the severity of each disaster. Four different categories of disasters are generated, which consist of a low, medium, high and very high number of deaths i.e., less than 100, between 100 and 499, between 500 and 999 and more than or equal 1000, respectively.

This paper uses the definition of governance indicators provided by Worldwide Governance Indicators as follows "governance consists of the traditions and institutions by which authority in a country is exercised. This includes the process by which governments are selected, monitored and replaced;

the capacity of the government to effectively formulate and implement sound policies; and the respect of citizens and the state for the institutions that govern economic and social interactions among them." The governance indicators are voice and accountability, regulatory quality, political stability and absence of violence, rule of law, government effectiveness and control of corruption. This paper uses the average of the ranking for the 6 indices, ranging from -2.5 to 2.5 with higher values corresponding to better governance (Kaufmann and Kraay, 2019).

4.2.2 Analytical framework

The dependent variable in each model is denoted by y_{it}, taking $y_{it} = 1$ when a punctuation occurs for country i at year t and $y_{it} = 0$ when a punctuation does not occur, where i is the country ID $(i = 1, \ldots\ldots, 191)$ and t is the year $(t = 1, \ldots\ldots, 20)$. Prob$(y_{it} = 1)$ represents the probability that country i faces a punctuation, following a distribution function F evaluated at $\boldsymbol{x}_{it}\boldsymbol{\beta}$, where $\boldsymbol{x}_{it}$ represents a $1 \times K$ vector of independent variables for country i at year t, $\boldsymbol{\beta}$ refers to a $K \times 1$ vector of regression coefficients estimated via standard maximum likelihood method and K is the number of independent variables in the regression. The panel logit regression model assumes a logit distribution function as follows (Wooldridge, 2010, 2019):

$$\text{Prob}(y_{it} = 1 | \boldsymbol{x}_{it}) = \frac{\exp(\boldsymbol{x}_{it}\boldsymbol{\beta})}{1 + \exp(\boldsymbol{x}_{it}\boldsymbol{\beta})} \tag{4.2}$$

This model can be utilized to estimate countries' marginal probability of facing punctuation, positive and negative punctuations when an independent variable changes by one unit. The set of the independent variables $\boldsymbol{x}_{it}$ includes last year's punctuation, health disasters, natural disasters, population, GDP, governmental debt, economic development, governance indicators and some interaction terms between these variables.

4.3 Results

Table 4.1 presents basic statistics for punctuation, natural and health disasters, population, gross domestic production (GDP) and governance indicators variables in developed, developing and the least developed countries over the period from 1995 to 2014. The economic development of countries is categorized into three categories i.e., developed, developing and the least developed countries following World Economic Situation Prospects (UNCTAD, 2018). Punctuation occurs on an average around 4 %, 9 % and 20 % of the observations in developed, developing and the least developed countries, respectively. On an average 40 % of the observations in developed, developing and the least developed countries face a natural disaster with a low number of deaths. The least developed countries face natural disasters with a medium, high and very high number of deaths more than developed and developing countries with an average of 20 %, 3 % and 3 %, respectively. The same trend holds for health disaster as the least developed countries have the highest frequency of health disaster occurrence among the three groups of countries. The population is the highest in developing countries with an average of 45.14 million people. GDP (governance indicators) is the highest (lowest) in developed (the least developed) countries. These descriptive statistics indicate that there are differences between developed, developing and the least developed countries in terms of punctuation occurrence, natural and health disasters, population, GDP and governance indicators.

Figure 4.1 presents the distribution of governance in developing, developed and the least developed countries, indicating that there are differences in the distributions among the three groups. The distribution of governance indicators for developed countries is skewed to the right with the peak value around 1.75. Developing countries and the least developed countries have normally distributed governance indicators with the highest values around -0.5 and -0.4. Figure 4.2 shows a boxplot for the distribution of governance indicators for the observations with and without punctuation (positive and negative punctuations) occurrences are recorded. Figure 4.2(a) corroborates that location parameters such as medians and quantiles for governance in observations without punctuation are higher than those with punctuation. Figures 4.2(b) and 4.2(c) show the same distribution for the observations with and

Table 4.1: Summary statistics

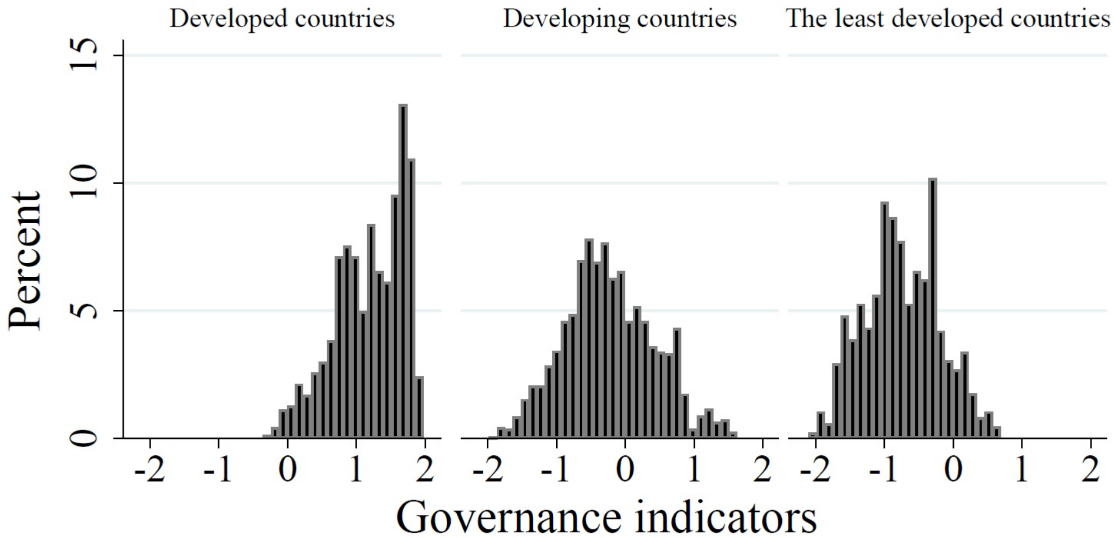
	Developed countries		Developing countries		The least developed countries		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Punctuation	0.04	0.19	0.09	0.28	0.20	0.40	0.11	0.31
Negative punctuation	0.01	0.12	0.05	0.22	0.11	0.31	0.06	0.23
Positive punctuation	0.02	0.15	0.04	0.19	0.09	0.29	0.05	0.21
Natural disasters								
Low no. deaths (< 100)	0.44	0.50	0.39	0.49	0.41	0.49	0.40	0.49
Medium no. deaths ($100 - 499$)	0.07	0.254	0.11	0.32	0.20	0.40	0.13	0.33
High no. deaths ($500 - 999$)	0.01	0.09	0.03	0.16	0.03	0.17	0.02	0.15
V.high no. deaths (≥ 1000)	0.02	0.12	0.03	0.17	0.03	0.17	0.03	0.16
Health disasters								
Low no. deaths (< 100)	0.01	0.10	0.09	0.28	0.17	0.38	0.09	0.29
Medium no. deaths ($100 - 499$)	0.00	0.04	0.02	0.15	0.10	0.30	0.04	0.19
High no. deaths ($500 - 999$)	0.00	0.00	0.01	0.08	0.02	0.15	0.01	0.10
V.high no. deaths (≥ 1000)	0.00	0.00	0.00	0.06	0.02	0.15	0.01	0.09
Population (in millions)	25.28	51.20	45.14	169.22	15.74	24.71	33.88	128.89
GDP (in millions)	878.61	2201.412	141.63	535.04	9.22	18.25	262.96	1125.89
Governmental debt	0.56	0.50	0.53	0.44	0.80	0.57	0.60	0.48
Governance indicators	1.19	0.51	-0.23	0.66	-0.743	0.55	-0.065	0.90
No. of countries	39		106		46		191	
Years ($1995 - 2014$)	20		20		20		20	
No. of observations	780		2120		920		3820	

without positive and negative punctuations, respectively, indicating that median and quantile follow the same pattern as in figure 4.2(a). These findings show that there are differences in governance indicators distribution when punctuation is observed among countries with different economic development levels.

To confirm these differences, a chi-square test is applied with the null hypothesis that the frequency distributions of punctuation occurrence in public health allocation are the same among different categories of natural and health disasters. The null hypothesis is rejected for natural disaster at $10\,\%$ significant level, but we fail to reject the null hypothesis for health disasters at $5\,\%$ significant level ($\chi^2 = 2.73, P = 0.605; \chi^2 = 12.96, P = 0.011$; respectively). We test the null hypothesis that the frequency of punctuation (positive and negative punctuations) occurrence in public health allocation is the same between developed, developing countries and the least developed countries by applying a chi-square test, and the null hypothesis is rejected at $1\,\%$ significant level with statistics of $\chi^2 = 133.013, P < 0.01$ ($\chi^2 = 54.17, P < 0.01; \chi^2 = 73.6, P < 0.01$; respectively). A Mann–Whitney test is run with the null hypothesis that the distribution of governance indicators is the same between the two groups. The null hypothesis is rejected, indicating that there are significant differences in the distribution of governance between the observations with and without punctuation (positive and negative punctuations) occurrence with statistics of $Z = 10.89, P < 0.01$ ($Z = 7.89, P < 0.01; Z = 10.89, P < 0.01$; respectively). These results show that disaster, economic development and governance indicators distributions are different between the countries with and without punctuation.

We apply panel logit regression to quantitatively characterize the marginal impact of natural disasters, health disasters, economic development and governance indicators on the probability of punctuation occurrence. In this regression, dummy variables for capturing the occurrence of punctuation, positive and negative punctuations in the yearly change of public health allocations are specified as dependent variables in models $1, 2$ and 3, receptively. On the other hand, economic development, natural and health disasters, population, GDP, governance indicators, governmental debt and some interaction terms are specified as independent variables in these regressions. Since a time-invariant independent

Figure 4.1: The distribution of governance among developed, developing, the least developed countries



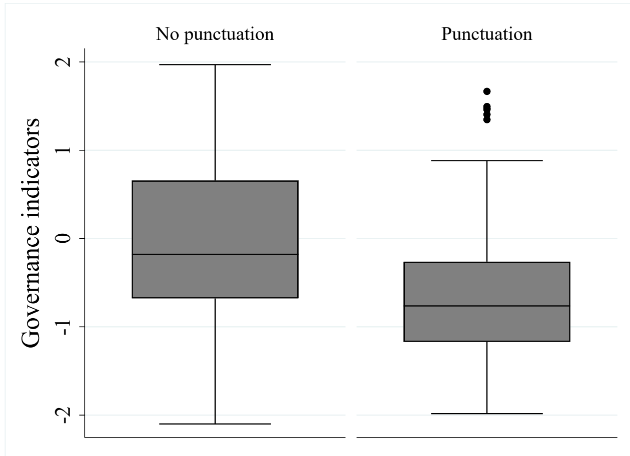
variable (i.e., economic development level) is included in the regression, we run random effects panel logit regression for models $1-3$ in table 4.2. With these models specifications, the models are estimated and the marginal effects of an independent variable on the likelihood of facing punctuation, positive and negative punctuations are calculated. Table 4.2 summarizes the estimation results and the associated marginal probabilities from the three panel logit regressions.

Punctuation is the dependent variable in model 1 of table 4.2. The results show that the marginal effects of natural disasters with a very high number of deaths and governance indicators (governmental debt and the least developed countries) are statistically significant at $1\,\%$ ($5\,\%$) level. In model 2 of table 4.2, positive punctuation is the dependent variable and the marginal effects (coefficients) of last year's punctuation, a natural disaster with a high number of deaths, governance indicators and governmental debt (the interaction terms between economic development and governance indicators) are statistically significant at $1\,\%$ ($5\,\%$) level. Negative punctuation is the dependent variable in model 3 of table 4.2 and the coefficient and the marginal effects for developing and the least developed countries, governance indicators and the interaction between them are statistically significant at $1\,\%$ level.

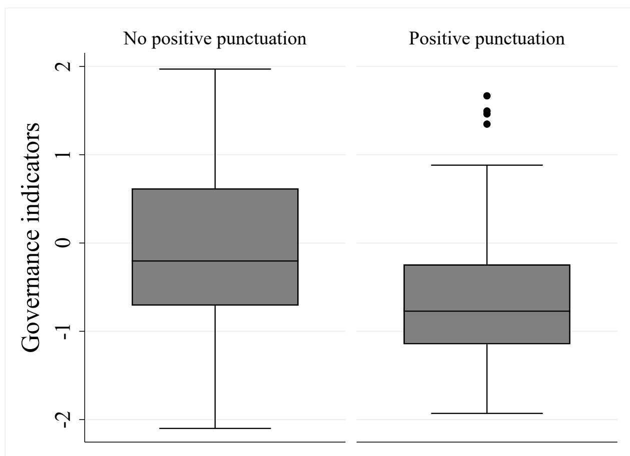
In particular, governance indicators have an economically significant effect on punctuation, positive and negative punctuations. The increase in governance indicators by one unit leads to a decline in the

Figure 4.2: Boxplot of governance indicators distribution with and without punctuation, positive and negative punctuations occurrence, where black dots represent outliers

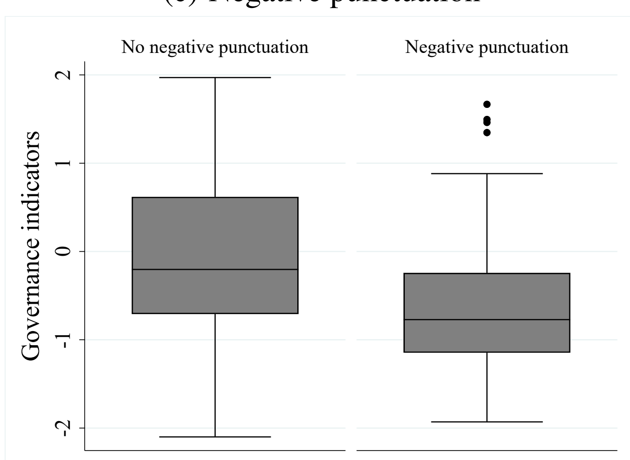
(a) Overall punctuation



(b) Positive punctuation



(c) Negative punctuation

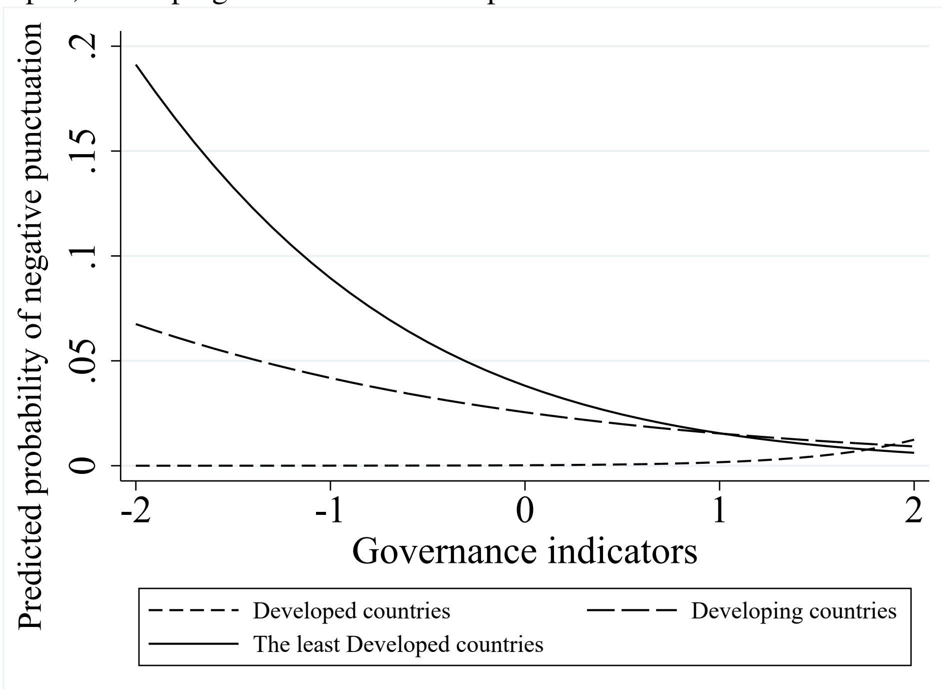


probability of punctuation, positive and negative punctuations occurrence by 3.9 %, 1.9 % and 2.4 %, respectively. Punctuation and negative punctuation tend to occur more in the least developed countries by 8.6 % and 5 % than in developed countries, respectively. Developing countries have a higher probability of facing negative punctuation than developed ones by 2.8 %. The occurrence of a natural disaster with a very high and high number of deaths reduces the probability of punctuation and positive punctuation occurrence by 5.2 % and 2.6 %, respectively. If punctuation, positive and negative punctuations occurred last year, the probability of facing positive punctuation in the current year increases by 2.3 %, 4.3 % and 2.2 %, respectively. The governmental debt is statistically significant in models 1 and 2, while the magnitude of its marginal effect is economically insignificant.

The coefficients for the interaction terms between economic development and governance indicators for the panel logit regression are positive (negative) in model 2 (3). This suggests that developing and the least developed countries have a different pattern for punctuation occurrence probability compared to developed countries in response to governance indicators. The interaction is estimated to be positive in model 2, indicating that the predicted probabilities of positive punctuation occurrence for developing and the least developed countries are smaller than those for developed countries as governance indicators decrease. In model 3, the interaction is negative, suggesting that the predicted probabilities of negative punctuation occurrence for developing and the least developed countries are larger than those for developed countries as governance indicators decrease. This shows that the increase of governance indicators for developing (the least developed) countries decrease the probability of having negative punctuation.

To quantitatively demonstrate how economic development affects the probability of negative punctuation differently, the predicted probabilities of negative punctuation over governance indicators in developed, developing and the least developed countries are calculated based on the estimation results of the model 3 in table 4.2. The predicted probability is calculated by changing governance indicators, holding other independent variables fixed at the sample mean. Figure 4.3 displays the predicted probabilities over governance indicators for developed, developing, and the least developed countries represented by the short-dashed, dashed, and solid lines, respectively. As seen in figure 4.3, the trajecto-

Figure 4.3: Predicted probability of negative punctuation occurrence as a function of governance indicators in developed, developing and the least developed countries



ries over governance indicators differ between developed, developing and the least developed countries. The predicted probability for developed countries is mostly constant over different levels of governance. When governance indicators reach 1.3, the predicted probability of facing negative punctuation starts to increase and becomes $2\,\%$ as governance indicators approach 2. On the other hand, when governance indicators are around -2, the predicted probabilities of negative punctuation for developing and the least developed countries become $7\,\%$ and $18\,\%$. This predicted probabilities of negative punctuation declines until it becomes the same level of developed countries i.e., $2\,\%$ as governance indicators reach around 1.8. These results indicate that improving governance in developing and the least developed countries reduce public health allocation instability.

4.4 Discussion

The findings suggest that governance indicators, economic development, and natural disasters are the main factors that determine stability of public health allocation. An important question here is

Table 4.2: Panel logit regression with a dummy variable of punctuation, positive and negative punctuations occurrence as dependent variables

Variables[1]	(1) Punctuation		(2) Positive punctuation		(3) Negative punctuation	
	Coefficient	Marginal effects	Coefficient	Marginal effects	Coefficient	Marginal effects
Last year's punctuation[2]	0.395*	0.023*	1.284***	0.043***	-0.650*	-0.022*
	(0.229)	(0.013)	(0.238)	(0.008)	(0.351)	(0.012)
Natural disaster						
No natural disaster (base group)						
Low no. deaths	0.049	0.003	0.219	0.007	-0.141	-0.005
	(0.187)	(0.0115)	(0.228)	(0.008)	(0.259)	(0.009)
Medium no. deaths	-0.342	-0.019	-0.055	-0.002	-0.629	-0.019
	(0.305)	(0.016)	(0.360)	(0.011)	(0.474)	(0.013)
High no. deaths	-0.638	-0.031	-1.422	-0.026***	0.142	0.006
	(0.778)	(0.031)	(1.068)	(0.011)	(0.991)	(0.042)
V.high no. deaths	-1.328*	-0.0521***	-0.462	-0.012	-	-
	(0.749)	(0.019)	(0.855)	(0.019)	-	-
Economic development level						
Developed countries (base group)						
Developing countries	1.216	0.036	-0.234	-0.134	4.944***	0.028***
	(1.009)	(0.028)	(0.825)	(0.132)	(1.254)	(0.004)
The least developed countries	1.900*	0.086**	0.382	-0.109	5.353***	0.050***
	(1.044)	(0.031)	(0.844)	(0.132)	(1.316)	(0.010)
Governance indicators	-0.693	-0.039***	-3.112**	-0.019***	2.063***	-0.024***
	(0.946)	(0.013)	(1.343)	(0.007)	(0.711)	(0.008)
Developing countries × Governance indicators	0.120	-	2.661**	-	-2.591***	-
	(0.982)	-	(1.380)	-	(0.752)	-
The least developed countries × Governance indicators	-0.066	-	2.547*	-	-3.015***	-
	(1.011)	-	(1.375)	-	(0.809)	-
Constant	-4.564***	-	-3.853***	-	-8.601***	-
	(1.009)	-	(0.833)	-	(1.260)	-
Wald χ^2	127.88***		166.07***		82.58***	
Observations	3,281		3,281		3,181	
Number of ID	180		180		180	

Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

[1] In models $1 - 3$, we control for health disaster, population and GDP and they are statistically insignificant.

[2] Last year's punctuation is last year's positive and negative punctuations in models 2 and 3, respectively.

why these factors influence public health allocation instability. It is our conjecture that developing and the least developed countries have limited financial resources, while the health sector needs numerous amount of resources to have significant tangible differences that citizens can feel. Thus, politicians and policymakers would prefer to focus on sectors that can produce immediate benefits in the short run. This leads to a frequent occurrence of negative punctuation in public health allocations for developing and the least developed countries compared to developed ones.

Several factors of governance indicators affect the budgetary process instability, such as political stability, absence of violence, voice, accountability, government effectiveness, control of corruption, regulatory quality and the rule of law. We argue that public health allocation instability can be determined by the extent to which a political system represents the public and the level of transparency and corruption in countries. When a political system represents the public (i.e., democratically elected) with high transparency and low corruption levels, governments pay attention to health sector allocations to be re-elected, leading to public health allocation stability over time. However, governments with low transparency and high corruption levels care about other sectors such as defense and infrastructure. Therefore, the priority and attention of policymakers might be given to such sectors, ignoring and destabilizing public health allocations.

4.5 Conclusion

This chapter analyzes the relationships among disasters, economic development, governance, and public health allocation instability, hypothesizing that disasters are the main determinants of public health allocation instability. Panel data of 191 countries from 1995 to 2014 is collected to test this hypothesis from various sources such as the Emergency Event Database (EM-DAT), World Development Indicators, The Global Health Observatory, Worldwide Governance Indicators and Historical Public Debt. The data analysis shows that disasters do not affect health allocation instability, while governance and economic development are the main influential factors for these allocations' stability. Our results suggest that public health allocation instability in countries with low economic development levels could be attributed to a lack of transparency, corruption and unrepresentative governments.

Chapter 5

Conclusion

Happiness for the current generation is commonly thought to be hard to achieve along with sustainability for future generations. Therefore, we conduct a survey experiment in this thesis's first study, collecting data from five subjective happiness scales, concern and commitment for future generations i.e., generativity, social value orientation and sociodemographic variables in one urban area (Dhaka) and two rural areas (Bogra and Gaibandha) in Bangladesh. We analyze the relationships among subjective happiness (SH), generativity and social preferences within a single analytical framework, posing a research question "Are people happier by being prosocial and/or generative for sustainability?" We find a positive association between happiness and generativity, while urbanization and household income has a positive relationship with happiness. In summary, generativity, income and residential area are the main determinants of happiness. This implies that the expected future urbanization will positively affect people's happiness if it can increase their generativity. It has been claimed that democracy and capitalism are not institutions that can maintain sustainability when people pursue happiness, and there are no social institutions or regimes are to do so (Hanley et al., 2006; Schumpeter, 2008). This is exemplified by the emergence of "climate change" and "accumulation of government debts" in many countries for the last decades. This chapter shows that people become happier by being more generative, suggesting that "future design" framework can enhance happiness and sustainability.

In the second chapter, we address the intergenerational sustainability dilemma (ISD) and how individuals behave under the ISD by applying a "future ahead and back mechanism" (FAB), where individuals are asked to be in the position of the future generations and give an advice to the previous generations, as a possible solution for the ISD. We also test FAB effectiveness to maintain sustainability in different ISD situations. Two hypotheses are posed (1) the application of FAB treatment will enhance the sustainable behavior of individuals and (2) that the economic factor (the prospective factor, i.e., the intergenerational sustainability index) and histories of previous generations' behaviors (i.e., the retrospective factor) affect the decisions made by the current generation in the ISD. A basic one-person ISD game (ISDG) treatment was designed and implemented with a strategy method in a laboratory experiment to examine the hypothesis. The experimental results in the basic ISDG treatment show that people are more likely to choose the unsustainable option as sustainability is increasingly endangered (i.e., the IS index is low and/or the percentage of previous generations that chose the unsustainable option is high). In other words, people are said to react to retrospective and prospective factors intuitively, in that no one chooses to be sustainable after previous generations have betrayed the current generation or if it appears too late to do anything about the current situation. On the other hand, the FAB mechanism is identified to positively influence individual behaviors for maintaining sustainability even in such an endangered situation.

In the third paper, we study public health allocation instability, which directly affects individual wellbeing. We collect panel data of 191 countries to study the factors that determine stability of public health allocations, hypothesizing that disasters are the main determinants of public health allocations' the instability. The results indicate that disasters do not affect public health allocation instability. However, governance and economic development are the main influential factors for public health allocations stability. Our results suggest that public health allocation instability in countries with low economic development levels could be attributed to a lack of transparency and corruption in addition to unrepresentative governments. Overall, our findings suggest that stability of public health allocation and caring about future generations could increase the current generation's wellbeing and happiness, leading to maintain stability and sustainability.

Finally, we note some limitations of our study and future avenues of research. The second chapter studies happiness, generativity and SVO with a small sample size because of budget and time constraints in only one country (i.e., Bangladesh), which is considered a culturally and ethnically homogeneous society. We believe that further studies with the same analytical framework in other countries with a large sample size will widen our understanding of generativity and some missing factors in relation to SH. In addition, we do not study the detailed mechanism of how and why generativity and happiness are positively associated. Therefore, future studies should be able to focus on addressing how each of the generative behaviors more directly influences happiness than the others by collecting finer individual behavioral data. Most importantly, future research should focus on clarifying whether and how economic growth affects generativity and happiness within a single framework. To this end, "future design," as a new field of research, can play an important role through applying some laboratory and field experiments and/or neuroscience to understand how people perceive or the brains react when people take and observe generative actions.

The third chapter does not address the detailed processes and channels of how and why the FAB mechanism affects individual behaviors in the ISD. To address these issues, two approaches can be suggested: (i) a neuropsychological approach and (ii) qualitative and deliberative interviews. The neuropsychological approach should allow the collection of various psychological scales and neuroimages to examine the possible processes and channels engaged when individuals make decisions under the FAB mechanism in the ISDG. In this way, a specific factor that influences individual behaviors may be identified (Vanderwolf, 1998; Watkins and Goodwin, 2019). Qualitative interviews and deliberative approaches have already been used by some economists and psychologists (Corbin and Strauss, 2014; Schulz et al., 2014; Rand, 2016; Palfrey et al., 2017). Individual interviews or group deliberations are conducted to clarify how individuals and groups reach decisions. Specifically, qualitative content analyses and text mining can be applied to untangle the detailed changes in individual behaviors that occur under the FAB mechanism in the ISDG.

The fourth chapter analyzes changes at the federal level of public health allocation data. However, these allocations can be influenced by the federal or local budget process. Future research could take the federal budgets and local budgets for each country, which would enable us to see the effect of disasters on local and national budgets to provide clear policy implications. This study does not include regime change due to the unavailability of a dataset for the whole observations used in this paper. Thus, missing factors such as regime change should be included in the analysis of punctuation by future studies. Such a study might reveal the effects of regime change on stability in overall governmental allocations as well. These caveats notwithstanding, we believe that this thesis is an essential first step to understand the relationship between public health allocations, happiness, stability and sustainability in addition to the mechanism to maintain sustainability for future generations.

NOMENCLATURE

AH Absolute self-rated happiness

DG Dictator game

GBC Generativity behavioral checklist

GSH General subjective happiness

GSU General subjective unhappiness

IS Intergenerational sustainability

ISD Intergenerational sustainability dilemma

ISDG Intergenerational sustainability dilemma game

OLS Ordinary least squares

OSH Overall subjective happiness

PRH Peer relative happiness

SD Standard deviation

SH Subjective happiness

SHS Subjective happiness scale

SVO Social value orientation

PET Punctuated equilibrium theory

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List of publications

1. Shahen, M. E., Kotani, K., and Saijo, T. (2021). Intergenerational sustainability is enhanced by taking the perspective of future generations. Scientific reports, 11:2437

2. Shahen, M. E., Kotani, K., Kakinaka, M., and Managi, S. (2020a). Wage and labor mobility between public, formal private and informal private sectors in a developing country. Economic analysis and policy, 68:101–113

3. Shahen, M. E., Masaya, W., Kotani, K., and Saijo, T. (2020c). Motivational factors in intergenerational sustainability dilemma: A post-interview analysis. Sustainability, 12:7078

4. Shahen, M. E., Shahrier, S., and Kotani, K. (2019). Happiness, generativity and social preferences in a developing country: A possibility of future design. Sustainability, 11:5256

List of conferences

1. "How do individuals behave in the intergenerational sustainability dilemma? A strategy method experiment" Labor Markets in South Asia: Evidence and Policy Lesson, IZA institute of labor economics, Nepal (2019,12)

2. "Economic analysis of individual behaviors for sustainability" Future design workshop, The Tokyo Foundation for Policy Research, Japan (2020.1)

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I would

like to dedicate this to

our ancestors and future generations.