Appendix 3

Analysis of life-happenings influencing the happiness and life-satisfaction based on longitudinal panel data from young Japanese women

Working Paper on Module-Happiness (H)

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by

Toshisuke OZAWA

National Institute of Advanced Industrial Science and Technology (AIST)
Research Center for Life Cycle Assessment
16-1 Onogawa, Tsukuba, Ibaraki 305-8569 JAPAN
Phone: +81-29-861-8107, FAX: +81-29-861-8118, E-mail:
t.ozawa@aist.go.jp

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1. Executive Summary

Attempts to reduce CO_2 emissions per capita prove to show limited success – if at all. Especially approaches relying primarily on technological progress that increases the energy efficiency of technologies and services have often failed to materialize expected reductions in fossil fuel consumption. State-of-the-art assessment of sustainable consumption has many shortcomings. Two shortcomings shall be addressed in this project:

3. Consumers rarely substitute one old consumption activity by one (and only one) new consumption activity. This yields to rebound effects that may turn the introduction of a new sustainable consumption activity into the reverse. Such behavioural changes in consumption are usually neglected.
4. LCA practitioner measure the utility of products and services often in units such as kg, meters, square meters, or piece, and economists often use willingness to pay. However, consumers strive for ultimate utility that can be approximated with measures of quality of life and subjective well-being. We suggest that the acceptability of changes towards sustainable consumption patterns can be improved when ultimate utility increases. This would also avoid compensational consumption addressed in point 1 above.

Therefore, we suggest testing a new method to quantitatively assess behavioural aspects of consumption and its consequences on environmental impacts and happiness. The method was demonstrated based on three concrete examples that are candidates for sustainable consumption activities. Using longitudinal panel data on household activities allows deriving consumption elasticities. These elasticities will be useful in predicting changes in consumption patterns. Changes in happiness or life satisfaction can be derived from the same data sample. Combining the activity-based calculation of life cycle CO_2 emissions calculated with a hybrid approach with information on change in consumption patterns and happiness allows identifying activities with lowest CO_2 emissions per unit of happiness. These activities are likely to escape the rebound effect and actually deliver lasting reduction in CO_2 emissions per capita. The work consists of three modules: consumption pattern (CP) module, CO_2 emission (C) module and happiness (H) module.

Module CP was executed by National Institute of Advanced Industrial Science and Technology (AIST) together with Büro für Analyse & Ökologie (BAO) to estimate the effects of adopting a new activity to household consumption patterns and happiness with using the longitudinal panel data (See Appendix 2 of this Final Report). The Institute for Research on Household Economics performs the Japanese Panel Survey of Consumers (JPSC), which includes the variables of happiness and life satisfaction along with other necessary variables for this study, such as time-use data and consumption data. Change in happiness was measured, however; it was speculated by authors that happiness may have been affected by various other factors: either internal factors that individuals have or external factors that they are exposed. The purpose of this Working Paper on Module H is to identify the factors influencing happiness or individuals, the Japanese young women for this particular study. Statistical analyses were performed to identify the correlations of "status" and "changes" of variables with those of happiness and life satisfaction. It was suggested that happiness seems to be rather subjective, related with self, whereas, life satisfaction is rather objective and rational. It was further suggested that the analysis of both status and changes of variable is necessary to better understand the relationships between the factors and ultimate utilities. The results of this module will be helpful learn what factors must be considered when we think about new technologies and services that have potential to lead to sustainable consumption.

2. Flow of Research

A conceptual schematic diagram of the links among relevant system parameters in sustainable consumption and the works of Modules CP, H and C to elucidate the causal relationships between them is shown in Figure 2-1. This diagram was developed by the authors to clarify the positions and contributions of our tasks to our research theme. Module C was performed by the Society of Non-Traditional Technology (SNTT) (Appendix 1) to calculate the activity-based life cycle CO_2 emissions with a hybrid approach with information on change in consumption patterns. Module CP was carried out to estimate the effects of adopting a new activity to household consumption patterns and happiness with using the longitudinal panel data. However, the analysis did not include the possible causal relationships between driving forces and limiting factors with consumption patterns and ultimate utility. The ultimate goal of Module H is to identify, and possibly, quantify the changes in happiness when the driving forces and limiting factors change, so that the genuine effects of the new sustainable development-related activities to happiness are better understood. Happiness was selected as acceptability indicator or ultimate utility indicator because it is a relevant driver in people's (consumption) behaviour. In addition, the importance of happiness as utility indicator in economics is growing. The data analysis of the JPSC will include results of change in life satisfaction which will be used in the suggested module.

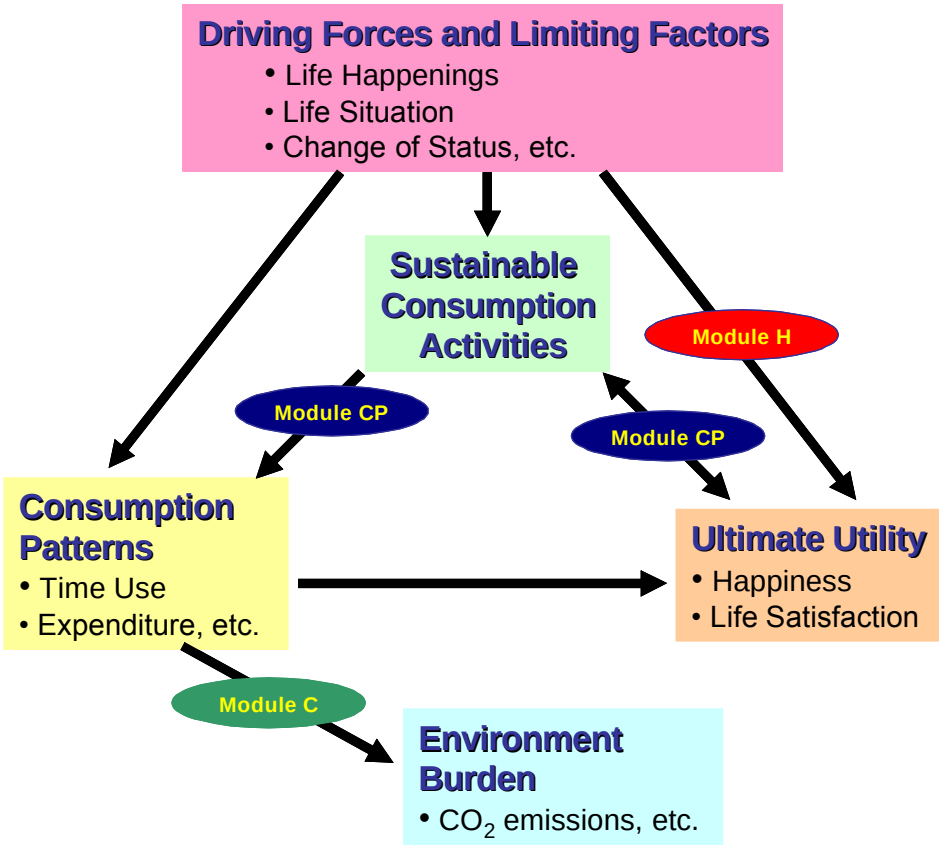

Figure 2-1 Schematic diagram of the links among relevant system parameters in sustainable consumption and causal relationships between them.

3. Used Data and Variables

The Japanese Panel Survey of Consumers (JPSC) dataset was provided from the Institute for Research on Household Economics (IRHE) of Japan. The JPSC longitudinal panel data include the variables of happiness and life satisfaction along with time-use data, consumption data necessary for our study. The characteristics of the used data are shown in Table 3-1. The panel cohort consists of at least 1,500 women who are geographically distributed throughout the nation. The latest dataset available is from the survey in 1999. The data consist of Cohort A (in the age range of 28-38 as of 1997) which has been covered since the first year's research in 1993, and Cohort B (in the age range of 24-27 as of 1997) which IRHE has covered since the fifth year's research in 1997. We decided to use the most recent available panel datasets (1997, 1998 and 1999), married and single samples combined, as well as Cohort A and B combined, for this study.

Table 3-1 Characteristics of data used for this study.

Panel Number	Survey Year	Number of Samples			Actual sample number used for this study	Age range at the time of survey
		Married	Single	Total		
Panel 5A*	1997	980	275	1,255	1,749	28-38
Panel 5B*	1997	201	299	500		24-27
Panel 6A	1998	952	244	1,196	1,628	29-39
Panel 6B	1998	211	231	442		25-28
Panel 7A	1999	931	206	1,137	1,537	30-40
Panel 7B	1999	215	197	412		26-29

* A and B represents Cohort A and Cohort B, respectively.

All the variables used for this study are listed in Table 3-2 through 3-16. The values and measure are dependent on the type of question in the survey. It is important to keep in mind the type of value measure of the variables when choosing a statistical tool for analyses. For this study, Toshisuke Ozawa, approved user of the JPSC data, performed statistical analysis using SPSS v.12.0J.

Table 3-2 Basic variables

Variable	Value	Measure
Panel number	5, 6, 7	Nominal
Year	5 = 1997, 6 = 1998, 7 = 1999	Nominal
Number of family member		Numerical
Level of wealth	1 = High, 2 = Middle-High, 3 = Middle, 4 = Middle-Low, 5 = Low	Ordinal

Table 3-3 Dependent variables

Variable	Value	Measure
Happiness	1 = Very Happy, 2 = Rather happy, 3 = Average, 4 = Rather unhappy, 5 = Unhappy	Ordinal
Satisfaction on life in general	1 = Satisfied, 2 = Rather satisfied, 3 = Average, 4 = Rather dissatisfied, 5 = Not satisfied	Ordinal

Table 3-4 Independent variables - Life changes in member of family members

Variable	Value	Measure
Gave a birth	1 = Yes, 2 = No	Nominal
Took parent(s) along home	1 = Yes, 2 = No	Nominal
Return of a family member	1 = Yes, 2 = No	Nominal
Increase for other reason	1 = Yes, 2 = No	Nominal
A family member transferred	1 = Yes, 2 = No	Nominal
A family member moved out	1 = Yes, 2 = No	Nominal
Loss by death	1 = Yes, 2 = No	Nominal
Loss for other reason	1 = Yes, 2 = No	Nominal
Married and left family	1 = Yes, 2 = No	Nominal
Divorced or separated	1 = Yes, 2 = No	Nominal
Left for an independent life	1 = Yes, 2 = No	Nominal
Started to live with parents	1 = Yes, 2 = No	Nominal
First child or not	1 = First Child, 2 = Second child, 3 = Third or more	Nominal

Table 3-5 Independent variables - Happenings to self

Variable	Value	Measure
Found a new job	1 = Yes, 2 = No	Nominal
Changed job	1 = Yes, 2 = No	Nominal
Quit job	1 = Yes, 2 = No	Nominal
Enrolled to a (graduate or professional) school	1 = Yes, 2 = No	Nominal
Started a new lesson/training	1 = Yes, 2 = No	Nominal
Took a leadership of a committee or organization	1 = Yes, 2 = No	Nominal
Illness requiring an operation or hospitalization	1 = Yes, 2 = No	Nominal
Depression/other psychiatric symptoms	1 = Yes, 2 = No	Nominal
Loan/credit card related trouble	1 = Yes, 2 = No	Nominal
Accident/disaster	1 = Yes, 2 = No	Nominal
Other	1 = Yes, 2 = No	Nominal

Table 3-6 Independent variables - Accidents, disasters, and consumer troubles

Variable	Value	Measure
Traffic accidents	1 = Yes, 2 = No	Nominal
Fire	1 = Yes, 2 = No	Nominal
Accidents while at work	1 = Yes, 2 = No	Nominal
Burglary or theft	1 = Yes, 2 = No	Nominal
Suffering from products	1 = Yes, 2 = No	Nominal
Bankruptcy	1 = Yes, 2 = No	Nominal
Other	1 = Yes, 2 = No	Nominal

Table 3-7 Independent variables - Happenings involving family

Variable	Value	Measure
Transferred	1 = Yes, 2 = No	Nominal
Vol. retirement or lost job	1 = Yes, 2 = No	Nominal
Business bankrupts	1 = Yes, 2 = No	Nominal
Illness requiring hospitalization or operation	1 = Yes, 2 = No	Nominal
Depression or other psychiatric problems	1 = Yes, 2 = No	Nominal
Credit card/loan-related trouble	1 = Yes, 2 = No	Nominal
Accident/disaster	1 = Yes, 2 = No	Nominal
Entrance exam and enrollment	1 = Yes, 2 = No	Nominal
Others	1 = Yes, 2 = No	Nominal

Table 3-8 Independent variables - Life changes

Variable	Value	Measure
Big expenditure	1 = Yes, 2 = No	Nominal
Income cut or depreciation of properties	1 = Yes, 2 = No	Nominal
Heavy burden on taking care	1 = Yes, 2 = No	Nominal
Lost good relationships with other family members	1 = Yes, 2 = No	Nominal
Depression	1 = Yes, 2 = No	Nominal
Devoiced or separated	1 = Yes, 2 = No	Nominal
Others	1 = Yes, 2 = No	Nominal

Table 3-9 Independent variables - Number of friends

Variable	Value	Measure
Total number of friends (female)		Numerical
Total number of friends (male)		Numerical
Number of friends to share concerns (female)		Numerical
Number of friends to share concerns (male)		Numerical
Number of inspiring friends (female)		Numerical
Number of inspiring friends (male)		Numerical

Table 3-10 Independent variables - Employment situation

Variable	Value	Measure
Wife – Employment situation	1 = Employed, 2 = Unemployed, 3 = Student, 4 = Housekeeper, 5 = Other	Nominal
Wife – Type of profession	1 = Agriculture/Forestry/Fishery (owner), 2 = Agriculture/Forestry/Fishery (hired), 3 = commerce and industry, manufacturing industry, services (owner) 4 = commerce and industry, manufacturing industry, services (hired), 5 = free profession, 6 = manager/administrator, 7 = professional staff, 8 = technological staff, 9 = teacher, 10 = office worker, 11 = technician, 12 = Marketing and service, 13 = Self employed	Nominal
Wife – Type of contract	1= Official staff, 2 = Part time worker, 3 = Consultant, other	Nominal
Wife – Type of payment	1 = Monthly, 2 = Weekly, 3 = Daily, 4 = Hourly, 5 = Other	Nominal
Wife - Paid overtime work (hour/week)	1 = 0 hour, 2 = 1- 3 hours, 3 = 4-5 hours, 4 = 6-10hours, 5 = 11-15 hours, 6 = 16-20 hours, 7 = more than 21 hours	Ordinal
Wife - Unpaid overtime work (hour/week)	1 = 0 hour, 2 = 1- 3 hours, 3 = 4-5 hours, 4 = 6-10hours, 5 = 11-15 hours, 6 = 16-20 hours, 7 = >21 hours	Ordinal
Wife - Working days (days/week)	1 = <50 days, 2 = 50-99 days, 3 = 100-149 Days, 4 = 150-174 days, 5 = 175-199 days, 6 = 200-224 days, 7 = 225-249 days, 8 = 250-274 days, 9 = 275-299 days, 10 = >300 days	Ordinal
Husband – Employment situation	1 = Employed, 2 = Unemployed, 3 = Student, 4 = Other	Nominal
Husband – Type of profession	1 = Agriculture/Forestry/Fishery (owner), 2 = Agriculture/ Forestry/ Fishery (hired), 3 = commerce and industry, manufacturing industry, services (owner) 4 = commerce and industry, manufacturing industry, services (hired), 5 = free profession, 6 = manager/administrator, 7 = professional staff, 8 = technological staff, 9 = teacher, 10 = office worker, 11 = technician, 12 = Marketing and service, 13 = Self employed	Nominal
Husband – Type of contract	1= Official staff, 2 = Part time worker, 3 = Consultant, other	Nominal
Husband – Type of payment	1 = Monthly, 2 = Weekly, 3 = Daily, 4 = Hourly, 5 = Other	Nominal
Husband - Paid overtime work (hour/week)	1 = 0 hour, 2 = 1- 3 hours, 3 = 4-5 hours, 4 = 6-10hours, 5 = 11-15 hours, 6 = 16-20 hours, 7 = >21 hours	Ordinal
Husband - Unpaid overtime work (hour/week)	1 = 0 hour, 2 = 1- 3 hours, 3 = 4-5 hours, 4 = 6-10hours, 5 = 11-15 hours, 6 = 16-20 hours, 7 = more than 21 hours	Ordinal
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Table 3-11 Independent variables - household income from the previous year, household savings and stocks possession (10,000 Yen)

Variable	Value	Measure
Household income from the previous year (husband)		Numerical
Household income from the previous year (wife)		Numerical
Household income from the previous year (couple)		Numerical
Household income from the previous year (other family member		Numerical
Total household income from the previous year		Numerical
Household savings		Numerical
Household stocks possession		Numerical
Total household savings and stocks possession		Numerical

Table 3-12 Independent variables - household expenditure per person for the month of September (1,000 Yen)

Variable	Value	Measure
Total		Numerical
Family in General		Numerical
Wife		Numerical
Husband		Numerical
Child(ren)		Numerical
Other		Numerical

Table 3-13 Independent variables - household spending allocation for the month of September (1,000 Yen)

Variable	Value	Measure
Food		Numerical
Housing (Rent/Mortgage)		Numerical
Water, Gas, Electricity		Numerical
Furniture and Household Appliances		Numerical
Clothing and Shoes		Numerical
Medical and Insurance		Numerical
Transportation		Numerical
Communication		Numerical
Education		Numerical
Hobby and Leisure		Numerical
Going out		Numerical
Allowances		Numerical

Table 3-14 Independent variables - housing situation

Variable	Value	Measure
Type of Housing	1 = A House, 2 = Dual house, 3 = reinforced-concrete apartment, 4 = Wooden apartment, 5 = Other	Nominal
Ownership	1 = Own house (land property included), 2 = Own house (Property partially included), 3 = Own house (property rented), 4 = Private apartment, 5 = Public apartment, 6 = Company/school owned housing, 7 = Other	Nominal
Mortgage / rent (1,000 Yen)		Numerical
Property Area (m^2)		Numerical
How to make payment	1 = At own expense (including loan), 2 = With parents' support, 3 = Joint investment with parents, 4 = Gift from parents, 5 = Inherited from parents, 6 = Other	Nominal
Whether have housing loan	1 = Yes, 2 = No	Nominal
Total due balance of Loan (10,000 Yen)		Numerical
Total payment made last year (10,000 Yen)		Numerical
Degree of the burden of housing loan	1 = Not a problem, 2 = Rather strained, 3 = Strained, 4 = in a very awkward position	Ordinal

Table 3-15 Independent variables - loans apart from housing

Variable	Value	Measure
If there is any that household has	1 = Yes, 2 = No	Nominal
Total due balance of Loans (10,000 Yen)		Numerical
Total payment made last year (10,000 Yen)		Numerical
New loan committed last year	1 = Yes, 2 = No	Nominal
The due balance of the new loan		Numerical
Degree of the burden of the loan other than housing loan	1 = Not a problem, 2 = Rather strained, 3 = Strained, 4 = in a very awkward position	Ordinal

Table 3-16 Independent variables - household possession of durable consumer good

Variable	Value	Measure
Dining Set		Numerical
Cupboard		Numerical
Microwave		Numerical
Refrigerator		Numerical
Automatic Dishwasher		Numerical
Vacuum cleaner		Numerical
Laundry machine		Numerical
Cloths Dryer		Numerical
Sewing machine		Numerical
Electric Fan		Numerical
Air Conditioner		Numerical
Fan Heater		Numerical
“Kotatsu” heater		Numerical
TV set		Numerical
Stereo Sound system		Numerical
CD Radio Cassette Recorder		Numerical
VCR		Numerical
Video Camera		Numerical
Telephone		Numerical
Bicycle		Numerical
Car		Numerical
TV Game		Numerical
Word Processor		Numerical
Personal computer		Numerical
FAX		Numerical
Mobile (Cellular) Phone		Numerical

4. The Approach and Procedure

Happiness, and perhaps, desire for life satisfaction, are the important driving forces to one's decision-making process of life. At the same time, happiness and life satisfaction can be affected by life events and various other factors. Therefore, it is important to identify and quantify the influences on happiness and life satisfaction as background information. This background information may help us better understand the literal causal relationships between concerning independent variables and the changes of happiness and life satisfaction in the case of adoption of sustainable consumption-related new activities. The panel data were analyzed via two different methods. The characteristics of the two analytical methods used for this study are shown in Table 4-1.

First method was cross sectional data analysis. We first constructed a series structure by three panel datasets from 1997, 1998 and 1999 and applied categorical multiple linear regression analysis to test the correlations between each independent variable with dependent variable. Linear regression analysis is used to predict the linear equation that expresses the dependent variable as a function of the independent variables which best fits in the observed values. Like simple linear regression analysis, categorical linear regression analysis utilizes a method of least-squares between response (dependent) and independent variables. However, categorical linear regression analysis is an expanded version of the simple linear regression approach by converting ordinal and nominal independent values into numerical values. Therefore, this method enables regression of numerical, ordinal and nominal measures simultaneously.

Second method was matched-pair longitudinal data analysis (tentatively named by the authors because no specific name has been found in literature available to us). We constructed a parallel structure data using two panel datasets from 1998 and 1999 and applied Kruskal Wallis' nonparametric analysis to compare the differences of the matched-pair "shift" of variables. Since the values of the former year (y-1) were subtracted from that of latter year (y), the measure needed to be either numerical or ordinal scale. Therefore, this method could not be applied for nominal data. In this study, the happiness variable divides the individuals into five groups: (1) very happy; (2) rather happy; (3) average; (4) rather unhappy; and (5) unhappy. When the mean values of only two groups are compared, Wilcoxon's Nonparametric analysis is applied, and when comparing more than three groups, Kruskal Wallis' nonparametric method is utilized [4]. In this study, the latter was utilized as there are five groups.

Table 4-1 The summary of the characteristics of two analytical methods used for this study

	Cross Sectional Data Analysis	Matched-Pair Longitudinal Data Analysis
Used analytical tool	Categorical multiple linear regression analysis	Kruskal Wallis' nonparametric Analysis
Value measure	Nominal, ordinal and nominal	Numerical and ordinal (limited)
Used analytical software	SPSS 12.0J	SPSS 12.0J
Used data	Panel 5, 6 and 7 (1997, 1998 and 1999)	Panel 6 and 7 (1998 and 1999)
Data structure	Series	Parallel
Calculate coefficient	Yes	No
Evaluates	Test the degree of correlations between each independent variable to dependent variable	Test of "difference" of means of two years
Background data	Cannot be identified or separated from the foreground data	Can be identified but not the degree if correlations
Evaluation of the relationships of variables at the static status	Yes	No
Evaluation of the relationships of the "changes" or "shifts" of variables	No	Yes

Both methods are capable of identifying the independent variables which may affect on happiness and life satisfaction. However, it is expected that estimating the effects of the relationships by simply comparing the mean values of variables of five groups by a single "cross-sectional" data may involve a logical error. Any differences found between the five groups of happiness may be a consequence of the activity itself or it may reflect some other prior differences between people that relates to their happiness and life satisfaction. The use of matched-pair longitudinal data analysis, on the other hand, is incapable of comparing the variables in nominal scale. Therefore, we decided to perform both methods to compensate for each other.

Table 4-1 The structure of the parallel data

id. No	Panel_5	Year_5	Happiness_5	Life satisfaction_5	Gave a birth_5	...	Panel_6	Year_6	Happiness_6	Life satisfaction_6	Gave a birth_6	...	Panel_7	Year_7	Happiness_7	Life satisfaction_7	Gave a birth_7	...
1	5	1997	Happy	Quite Satisfied	No	...	6	1998	Happy	Satisfied	No	...	7	1999	Happy	Satisfied	No	...
2	5	1997	Very Happy	Satisfied	No	...	6	1998	Very Happy	Satisfied	No	...	7	1999	Very Happy	Satisfied	No	...
3	5	1997	Very Happy	Satisfied	No	...	6	1998	Happy	Satisfied	No	...	7	1999	Happy	Satisfied	No	...
4	5	1997	Very Unhappy	Dissatisfied	No	...	6	1998	Average	Not too satisfied	No	...	7	1999	Average	Not too satisfied	No	...
6	5	1997	Happy	Satisfied	No	...	6	1998	Happy	Satisfied	No	...	7	1999	Happy	Satisfied	Yes	...
7	5	1997	Very Happy	Quite Satisfied	No	...	6	1998	Very Happy	Quite Satisfied	No	...	7	1999	Very Happy	Quite Satisfied	No	...
8	5	1997	Happy	Average	No	...	6	1998	Happy	Not too satisfied	No	...	7	1999	Happy	Average	No	...
13	5	1997	Very Happy	Satisfied	No	...	6	1998	Average	Average	No	...	7	1999	Happy	Average	No	...
14	5	1997	Happy	Average	No	...	6	1998	Average	Not too satisfied	No	...	7	1999	Happy	Average	No	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

id. No	Panel No.	Year	Happiness	Life Satisfaction	Gave a birth	...
1	5	1997	Happy	Quite Satisfied	No	...
2	5	1997	Very Happy	Satisfied	No	...
3	5	1997	Very Happy	Satisfied	No	...
4	5	1997	Very Unhappy	Dissatisfied	No	...
6	5	1997	Happy	Satisfied	No	...
7	5	1997	Very Happy	Quite Satisfied	No	...
8	5	1997	Happy	Average	No	...
13	5	1997	Very Happy	Satisfied	No	...
14	5	1997	Happy	Average	No	...
...	...	...	...	...	...	...
1	6	1998	Happy	Satisfied	No	...
2	6	1998	Very Happy	Satisfied	No	...
3	6	1998	Happy	Satisfied	No	...
4	6	1998	Average	Not too satisfied	No	...
6	6	1998	Happy	Satisfied	No	...
7	6	1998	Very Happy	Quite Satisfied	No	...
8	6	1998	Happy	Not too satisfied	No	...
13	6	1998	Average	Average	No	...
14	6	1998	Average	Not too satisfied	No	...
...	...	...	...	...	...	...
1	7	1999	Happy	Satisfied	No	...
2	7	1999	Very Happy	Satisfied	No	...
3	7	1999	Happy	Satisfied	No	...
4	7	1999	Average	Not too satisfied	No	...
6	7	1999	Happy	Satisfied	Yes	...
7	7	1999	Very Happy	Quite Satisfied	No	...
8	7	1999	Happy	Average	No	...
13	7	1999	Happy	Average	No	...
14	7	1999	Happy	Average	No	...
...	...	...	...	...	...	...

Table 4-2 The structure of the series data

The original datasets obtained from IRHE were separated by panel. We decided to use the most recent three panel data sets available. Panels 5, 6 and 7, from year 1997, 1998 and 1999, respectively, were combined. Two different panel structures were necessary to modify the original longitudinal panel data, namely parallel and series. The simplified examples of the panel structures are shown in Table 4-1 and 4-2.

The parallel structure was developed for various purposes. One purpose was to identify any cases that are missing in the three consecutive years. All the cases (or individuals) that are missing in any of the two years were excluded from the analysis.

5. Results of the Analyses and Discussions

A. Cross Sectional Data Analysis

Number of frequencies for panels 5, 6 and 7 are 1520 each, as shown in Table 5-1. For the analysis, these panels were combined to increase the sample numbers. Figures 5-1 and 5-2 show the histograms of happiness and life satisfaction cases for the combined data of panels 5, 6 and 7. The shapes of the presented histograms are similar to each other. In both cases, most of the respondents feel that they are rather happy and rather satisfied with life, but not completely. It can be said that Japanese young women have positive attitude against their lives.

Table 5-1 Frequencies of the panel data used for the analysis.

Panel No.	Year	Frequency
5	1997	1,520
6	1998	1,520
7	1999	1,520
Total		4,560

The total number of all the samples is 4,560. However, ten and twelve samples are missing for the cases of happiness data and life satisfaction data, respectively. Missing data are always found in the following analysis due to the fact that some variables are applicable only for certain individuals.

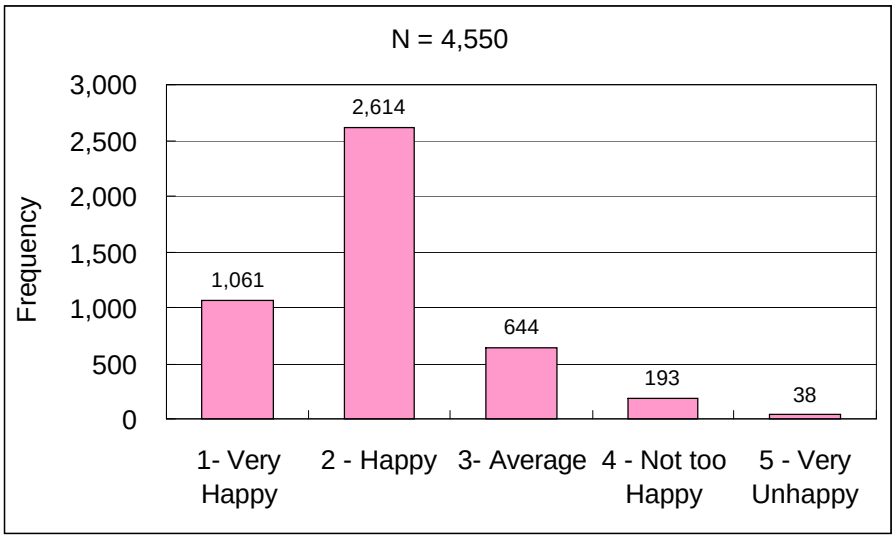

Figure 5-1 Histogram of happiness cases for the combined data of panels 5, 6 and 7.

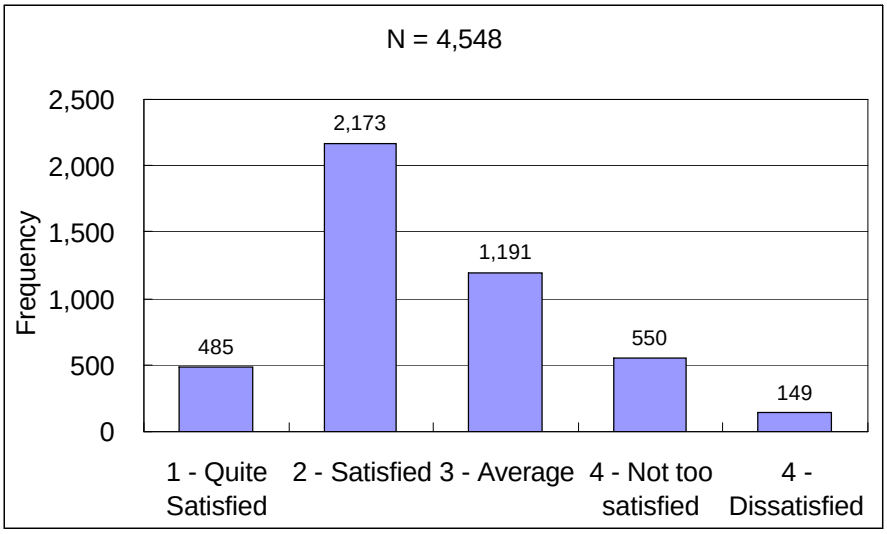

Figure 5-2 Histogram of life-satisfaction cases for the combined data of panels 5, 6 and 7.

The results from cross sectional data analysis are shown in Tables 5-2 – 5-16. The Beta values with yellow highlights are determined to be significant, in which the observed significance level (S.L.) is lower than the rejection level of P = 0.05. In this study, these significant Beta values (coefficients for variables), are representatives for the "effects" of the variables on happiness and life satisfaction. The detailed outputs of this analysis are attached in ANNEX in the last part of this working paper.

Both "number of family members" and "level of wealth" have positive effects on both happiness and life satisfaction (Table 5-2). Beta value of "level of wealth" to life satisfaction is higher than that of happiness (Table 5-2). It is implied that wealth increases people's satisfaction but no as much of happiness. In the case of "giving a birth", happiness is more affected than life satisfaction (Table 5-3). It seems that happiness is more related with emotional or subjective matter. When it comes to the "loss of a family member", life satisfaction is more affected than happiness (Table 5-3). We supposed that it would have been emotional matter; however, happiness was not affected. "Married and left for a new family" increased both happiness and life satisfaction as we expected (Table 5-3) because it is one of the biggest life events. It was interesting that "finding a new job" and "starting a new lesson/training" decrease one's life satisfaction and happiness, respectively (Table 5-4). We could not find any explanations for that effect. Another interesting matter is that the variables related with accidents, disasters and consumer troubles had no impact to happiness or life satisfaction (Table 5-5). It is probably because these happenings are normally non-serial. It is only a speculation, but as opposed to continuous matter, people may be capable of forgetting negative incidents to self. "Voluntary retirement or lost job" and "depression or other psychiatric problems" negatively impacted life satisfaction but not happiness (Table 5-6). In the same table are "credit card/loan-related trouble" and "other", decreasing both happiness and life satisfaction. Variables related to health and money may have greater impacts to them. Income cut or depreciation of properties greatly negatively affected life satisfaction (Table 5-7). Again monetary matters are observed to have great impacts on life satisfaction. In the same table are "loss of good relationships with other family members" and "depression", both again, have great negative influence on both happiness and life satisfaction. It is strongly suggested that "relationships with other individual" have a great influence on happiness and life satisfaction. Number of inspiring friends (female = same gender) have big influence on happiness. A negative sign is placed on the Beta value. We could not come up with any reasoning as to why the increase of inspiring friends decreases one's happiness. In the table of employment situation (Table 5-8), type of payment (hourly, daily, weekly and monthly), working days, annual leave taken, paid overwork hours and working days per week have effect on both happiness and life satisfaction. There is a mix of positive and negative numbers in the columns. That is due to the "ordinal" scale of the variables.

Closer look will be necessary to understand the details of the effects. Table 5-10 shows positive and negative effects of total household income from the previous year and total household savings and stocks possession to happiness. The measure of the variables is numerical. There may be some other factors associated with the effects behind these numbers. The same may hold true for the amount of expenditure for family in general indicated in Table 5-12. Increasing expenditure for food has positive effect on happiness, and that for clothing and shoes has negative effect. Both items are more subjective compared with the other items in the same table. Expenditure for education, rather objective or rational matter, affects life satisfaction. In the case of housing situation, "type of housing", "how to pay", and "degree of the burden of housing loan" are the main influences on both happiness and life satisfaction (Table 5-14). Housing seems to be objective; however, it may be one of representatives for subjective matters as many Japanese young couples have strong desire of buying their own house and dream about it. Therefore, obtaining a house is quite an important event to one's life. On the other hand, heavy burden of loans imposes on many Japanese people's happiness and life satisfaction (Table 5-16). Table 5-16 shows many significant differences on life-satisfaction columns. Again possession of goods, which is included in objective matter, is indicated to have effects on life satisfaction rather than happiness.

Table 5-2 Basic variables

	Happiness		Life Satisfaction	
	Beta	Observed S.L	Beta	Observed S.L
Number of family members	.058	.000	.069	.000
Level of wealth	.294	.000	.402	.000

Table 5-3 Life changes in member of family members

	Happiness		Life Satisfaction	
	Beta	Observed S.L	Beta	Observed S.L
Gave a birth	.098	.000	.047	.003
Took parent(s) along home	-.002	.921	.000	.981
Return of a family member	-.004	.809	-.014	.352
Increase for other reason	.005	.725	-.007	.654
A family member transferred	-.009	.541	-.025	.106
A family member moved out	-.010	.514	.013	.401
Loss by death	-.007	.647	-.034	.027
Loss for other reason	-.021	.181	.016	.308
Married and left family	.073	.000	.064	.000
Divorced or separated	-.022	.170	-.012	.445
Left for an independent life	-.001	.928	.020	.202
Started to live with parents	-.009	.584	-.018	.263

Table 5-4 Happenings to self

	Happiness		Life Satisfaction	
	Beta	Observed S.L	Beta	Observed S.L
First child	.039	.545	.080	.198
Found a new job	.018	.772	-.226	.000
Changed job	-.015	.796	.039	.504
Quit job	-.024	.702	-.075	.218
Enrolled to a (graduate or professional) school	.058	.352	-.029	.637
Started a new lesson/training	-.145	.019	-.042	.490
Illness requiring an operation or hospitalization	-.052	.398	-.034	.576
Depression/other psychiatric symptoms	.055	.370	-.044	.471
Accident/disaster	.081	.180	-.029	.625
Other	-.027	.663	.038	.526

Table 5-5 Accidents, disasters, and consumer troubles

	Happiness		Life Satisfaction	
	Beta	Observed S.L	Beta	Observed S.L
Traffic accidents	.138	.638	.208	.485
Fire	.012	.913	.057	.613
Accidents while at work	-.190	.123	-.099	.427
Burglary or theft	.202	.337	.059	.782
Suffering from products	-.004	.974	.068	.563
Bankruptcy	.058	.722	.115	.487
Other	-.081	.612	-.078	.632

Table 5-6 Happenings involving family

	Happiness		Life Satisfaction	
	Beta	Observed S.L	Beta	Observed S.L
Transferred	.025	.112	.011	.460
Vol. retirement or lost job	-.001	.939	-.052	.001
Business bankrupts	.010	.510	-.010	.512
Illness requiring hospitalization or operation	-.011	.469	-.005	.756
Depression or other psychiatric problems	-.004	.800	-.048	.002
Credit card/loan-related trouble	-.090	.000	-.055	.000
Accident/disaster	-.023	.141	.000	.993
Entrance exam and enrollment	.008	.626	.003	.845
Others	-.065	.000	-.057	.000

Table 5-7 Life changes

	Happiness		Life Satisfaction	
	Beta	Observed S.L	Beta	Observed S.L
Big expenditure	-.005	.860	-.039	.187
Income cut or depreciation of properties	-.040	.186	-.112	.000
Heavy burden on taking care	.055	.070	.005	.862
Lost good relationships with other family members	-.195	.000	-.137	.000
Depression	-.118	.000	-.141	.000
Devoiced or separated	.051	.088	-.046	.124
Others	.016	.589	.018	.546

Table 5-8 Number of friends

	Happiness		Life Satisfaction	
	Beta	Observed S.L	Beta	Observed S.L
Total number of friends (female)	-.093	.555	-.144	.375
Total number of friends (male)	-.074	.632	.114	.473
Number of friends to share concerns (female)	-.001	.996	.096	.505
Number of friends to share concerns (male)	.114	.324	.024	.838
Number of inspiring friends (female)	-.348	.027	-.238	.138
Number of inspiring friends (male)	.075	.614	-.113	.459

Table 5-9 Employment situation

	Happiness		Life Satisfaction	
	Beta	Observed S.L	Beta	Observed S.L
Wife – Employment situation	-.052	.236	.021	.628
Wife – Type of contract	.226	.000	.055	.359
Wife – Type of payment	-.104	.048	-.147	.001
Wife - Paid overtime work (hour/week)	.098	.005	.013	.956
Wife - Unpaid overtime work (hour/week)	.012	.789	.131	.000
Wife - Working days (days/week)	.117	.000	.125	.000
Wife – Annual leave days	.068	.057	-.181	.000
Wife – Annual leave taken	.112	.000	.256	.000
Husband – Type of contract	.077	.107	-.295	.000
Husband – Type of payment	.064	.196	.026	.537
Husband - Paid overtime work (hour/week)	.106	.002	-.081	.009
Husband - Unpaid overtime work (hour/week)	.080	.033	.007	.869
Husband - Working days (days/week)	.115	.001	-.427	.000

Table 5-10 Household income from the previous year, household savings and stocks possession (10,000 Yen)

	Happiness		Life Satisfaction	
	Beta	Observed S.L	Beta	Observed S.L
Total Household Income from the Previous Year	.207	.001	-.112	.067
Total Household Savings and Stocks Possession	-.148	.014	.023	.704

Table 5-11 Household income per family member (10,000 Yen)

	Happiness		Life Satisfaction	
	Beta	Observed S.L	Beta	Observed S.L
Household income from the previous year (husband)	.199	.637	-.388	.353
Household income from the previous year (wife)	.152	.745	.016	.971
Household income from the previous year (couple)	.501	.169	-.056	.866
Household income from the previous year (other family member	-.524	.172	-.405	.266

Table 5-12 Household expenditure per person for the month of September (1,000 Yen)

	Happiness		Life Satisfaction	
	Beta	Observed S.L	Beta	Observed S.L
Family in General	-.052	.165	-.090	.017
Wife	.067	.086	-.007	.862
Husband	.005	.895	-.003	.930
Child(ren)	-.004	.921	-.009	.825
Other	-.002	.963	-.032	.388

Table 5-13 Household spending allocation for the month of September (1,000 Yen)

	Happiness		Life Satisfaction	
	Beta	Observed S.L	Beta	Observed S.L
Food	.294	.011	.007	.949
Housing (Rent/Mortgage)	.000	.999	-.021	.836
Water, Gas, Electricity	.033	.781	.051	.654
Furniture and Household Appliances	.009	.929	-.041	.666
Clothing and Shoes	-.244	.017	-.048	.620
Medical and Insurance	.020	.841	-.049	.618
Transportation	.098	.349	-.092	.362
Communication	.132	.351	.120	.380
Education	.056	.656	.377	.003
Hobby and Leisure	.119	.233	.003	.975
Going out	-.120	.292	-.019	.862
Allowances	-.222	.070	.094	.421

Table 5-14 Housing situation

	Happiness		Life Satisfaction	
	Beta	Observed S.L	Beta	Observed S.L
Property Area (m^2)	-.077	.083	-.020	.642
Total payment made last year (10,000 Yen)	-.072	.113	-.069	.116
Total due balance of Loan (10,000 Yen)	.007	.884	.013	.769
Type of Housing	.119	.007	.140	.001
How to make payment	.076	.036	.155	.000
If there is any that household has	.071	.108	-.056	.190
Degree of the burden of housing loan	.366	.000	.372	.000

Table 5-15 Loans apart from housing

	Happiness		Life Satisfaction	
	Beta	Observed S.L	Beta	Observed S.L
Total due balance of Loans (10,000 Yen)	.108	.062	-.006	.922
Total payment made last year (10,000 Yen)	-.050	.317	-.033	.509
New loan committed last year	-.044	.430	-.076	.168
Degree of the burden of the loan other than housing loan	.206	.000	.332	.000

Table 5-16 Household possession of durable consumer good

	Happiness		Life Satisfaction	
	Beta	Observed S.L	Beta	Observed S.L
Dining Set	.696	.277	1.016	.012
Cupboard	1.102	.010	.667	.003
Microwave	-.983	.139	-.267	.350
Refrigerator	.087	.763	.297	.066
Laundry machine	-.922	.041	.102	.542
Cloths Dryer	-.203	.272	-.615	.000
Sewing machine	.170	.405	-.565	.001
Electric Fan	.258	.232	.042	.650
Air Conditioner	-.171	.603	.171	.286
Fan Heater	-.098	.682	-.102	.376
“Kotatsu” heater	.485	.161	-.377	.040
TV set	-.614	.389	.106	.741
Stereo Sound system	.327	.427	-1.479	.000
CD Radio Cassette Recorder	-.252	.270	.090	.386
VCR	.270	.106	.287	.006
Video Camera	.591	.093	.143	.331
Telephone	.019	.880	-.249	.006
Bicycle	.234	.084	.062	.277
Car	-.126	.535	.026	.776
TV Game	-.349	.077	-.217	.031
Word Processor	.156	.217	.343	.001
Personal computer	.129	.431	-.013	.855
Mobile (Cellular) Phone	-.009	.957	.256	.016

B. Matched-Pair Changes of Variables between Happiness and Life Satisfaction Groups

It was expected that estimating the effects of variables on happiness and life satisfaction by simply comparing the correlation coefficients (Beta) of variables of a single "cross-sectional" data, shown in the previous section, have a great potential involving a logical error. Therefore, we decided to analyze the correlations between the "changes" of each dependent and independent variable in two consecutive years. The value of previous year (y-1) was subtracted from that of later year (y) on an individual base. Parallel structured dataset was used for the calculation of the "changes" of the variables between two years. In this study, we decided to take datasets from Panel 7 (1999) and Panel 6 (1998) to calculate the "difference" of values between two years. The variables shown in Tables 3-2 – 3-16 contain numerical, ordinal and nominal scales. Moreover, there is a possibility that the distribution of the differences do not fall in the Normal distribution. Therefore, nonparametric analysis was required [4]. This method is applicable on the comparisons of numerical data but not nominal data. In the case of ordinal data, it normalizes then to compare. Then, Kruskal Wallis' nonparametric statistical method was used to analyze the data.

Figures 5-3 and 5-4 show the distribution of the "change" of happiness and life satisfaction between 1998 and 1999, respectively. Again the shapes of these distributions look similar to each other.

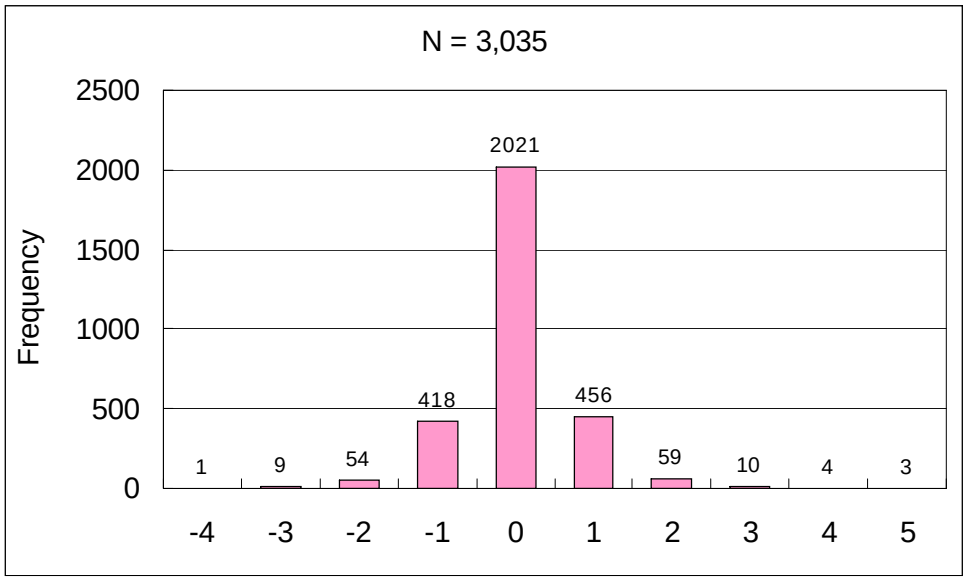

Figure 5-3 Distribution of the "change" of happiness between 1998 and 1999.

Tables 5-7 and 5-8 show the possible combinations of the "changes" in happiness and life satisfaction. The values of happiness and life satisfaction variables were expressed in an ordinal scale. They are: 1 = Very Happy, 2 = Rather happy, 3 = Average, 4 = Rather unhappy, 5 = Unhappy, for happiness, and 1 = Satisfied, 2 = Rather satisfied, 3 = Average, 4 = Rather dissatisfied, 5 = Dissatisfied, for life satisfaction. A convergent of the combination cases and higher frequencies of results at zero is observed. The actual constituents out of the possible combinations are not defined in this study. Therefore, the results of this analysis do not account for the "state" (or level of happiness and life satisfaction they are at) but provides the insights only on the actual "changes" (or shifts) in variables.

Table 5-7 Combinations of Changes in Happiness

Expression of Changes	Frequency	Case of combinations of shifts in happiness				
-3	4	1-4	2-5			
-2	31	1-3	2-4	3-5		
-1	201	1-2	2-3	3-4	4-5	
0	1038	5-5	4-4	3-3	2-2	1-1
1	214	5-4	4-3	3-2	2-1	
2	22	5-3	4-2	3-1		
3	7	5-3	4-1			

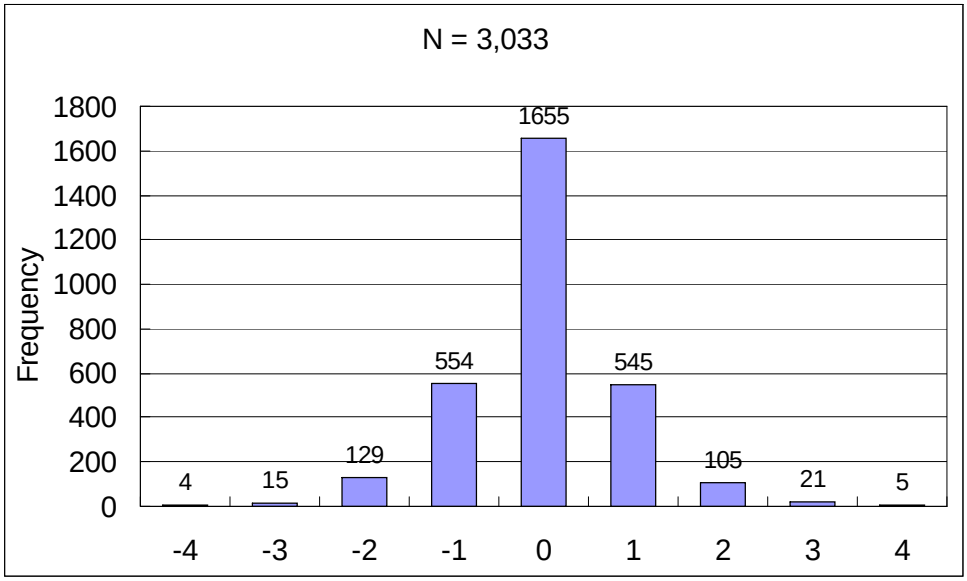

Figure 5-4 Distribution of the "change" of life satisfaction between 1998 and 1999.

Table 5-18 Combinations of Changes in Life Satisfaction

Expression of Changes	Frequency	Case of combinations of shifts in life satisfaction				
-4	2	1-5				
-3	8	1-4	2-5			
-2	60	1-3	2-4	3-5		
-1	272	1-2	2-3	3-4	4-5	
0	846	5-5	4-4	3-3	2-2	1-1
1	275	5-4	4-3	3-2	2-1	
2	46	5-3	4-2	3-1		
3	10	5-3	4-1			
4	1	5-1				

The followings are the results of the Matched-Pair Changes analysis on happiness and life-satisfaction performed with using SPSS 12.0J. Notice that nonparametric analysis is a group of $Chai^2$ analysis. These tables indicate statistical significance but coefficients like Beta values are not provided as it is not a regression analysis.

"Number of family member" has effects on both happiness and life satisfaction, and "level of wealth" effects on happiness although the degrees of correlations are not provided (Table 5-19). "Giving a birth" and "marrying" are both significant for one's happiness. Job-related variables, such as finding and quitting, are significant but not consistent in the independent variables (Table 5-21). "Loan/credit card related trouble", again, have effect on happiness. Being "transferred", "voluntary retirement or lost job" and "business bankruptcy" are significant in life satisfaction (Table 5-22). "Loosing good relationships with other family member" in Table 5-23 is significant

to happiness. "Type of payment" and "paid overtime work" in Table 5-25 and "household income (husband)" in Table 5-27, and "expenditure for family in general" in Table 5-28, "food expenditure" in Table 5-29, and finally, "bicycle" in Table 5-31, have significant effect on happiness and life satisfaction, although not having consistency in targets.

Table 5-19 Basic variables

Variable	Happiness			Life Satisfaction		
	Chai^2	DF	Sig. Level	Chai^2	DF	Sig. Level
Level of wealth	6.870	2	0.032	8.604	3	0.035
Number of family member	7.818	2	0.020	6.658	3	0.084

Table 5-20 Life changes in member of family members

Variable	Happiness			Life Satisfaction		
	Chai^2	DF	Sig. Level	Chai^2	DF	Sig. Level
Gave a birth	15.067	2	0.001	11.276	3	0.010
Took parent(s) along home	0.000	2	1.000	2.070	3	0.558
Return of a family member	0.136	2	0.934	0.207	3	0.976
Increase for other reason	2.073	2	0.355	4.287	3	0.232
A family member transferred	0.272	2	0.873	1.022	3	0.796
A family member moved out	3.578	2	0.167	2.284	3	0.516
Loss by death	0.179	2	0.915	0.000	3	1.000
Loss for other reason	0.136	2	0.934	7.068	3	0.070
Married and left family	9.660	2	0.008	1.820	3	0.611
Divorced or separated	0.046	2	0.977	0.000	3	1.000
Left for an independent life	3.033	2	0.220	1.757	3	0.624
Started to live with parents	0.028	2	0.986	2.201	3	0.532

Table 5-21 Happenings to self

Variable	Happiness			Life Satisfaction		
	Chai^2	DF	Sig. Level	Chai^2	DF	Sig. Level
Found a new job	0.736	2	0.692	10.187	3	0.017
Changed job	1.304	2	0.521	7.738	3	0.052
Quit job	8.461	2	0.015	1.434	3	0.698
Enrolled to a (graduate or professional) school	4.251	2	0.119	0.813	3	0.846
Started a new lesson/training	1.261	2	0.532	2.603	3	0.457
Took a leadership of a committee or organization	2.254	2	0.324	2.327	3	0.507
Illness requiring an operation or hospitalization	4.912	2	0.086	0.126	3	0.989
Depression/other psychiatric symptoms	4.574	2	0.102	4.913	3	0.178
Loan/credit card related trouble	14.586	2	0.001	0.404	3	0.939
Accident/disaster	3.679	2	0.159	1.726	3	0.631
Other	6.629	2	0.036	1.211	3	0.750

Analysis not executable due to lack of data samples.

Table 5-22 Happenings involving family

Variable	Happiness			Life Satisfaction		
	Chai^2	DF	Sig. Level	Chai^2	DF	Sig. Level
Transferred	0.164	2	0.921	15.711	3	0.001
Vol. retirement or lost job	2.646	2	0.266	10.285	3	0.016
Business bankrupts	0.046	2	0.977	9.602	3	0.022
Illness requiring hospitalization or operation	1.779	2	0.411	1.316	3	0.725
Depression or other psychiatric problems	2.200	2	0.333	0.567	3	0.904
Credit card/loan-related trouble	0.850	2	0.654	0.235	3	0.972
Accident/disaster	0.892	2	0.640	0.695	3	0.874
Entrance exam and enrollment	0.288	2	0.866	2.425	3	0.489
Others	24.367	2	0.000	8.054	3	0.045

Table 5-23 Life changes

Variable	Happiness			Life Satisfaction		
	Chai^2	DF	Sig. Level	Chai^2	DF	Sig. Level
Big expenditure	0.079	1	0.779	0.090	1	0.764
Income cut or depreciation of properties	0.024	1	0.876	0.768	1	0.381
Heavy burden on taking care	0.100	1	0.752	0.128	1	0.720
Lost good relationships with other family members	7.734	1	0.005	0.412	1	0.521
Depression	0.100	1	0.752	2.454	1	0.117
Devoiced or separated	0.031	1	0.860	0.352	1	0.553
Others	4.813	1	0.028	1.148	1	0.284

Table 5-24 Number of friends

Variable	Happiness			Life Satisfaction		
	Chai^2	DF	Sig. Level	Chai^2	DF	Sig. Level
Total number of friends (female)	0.352	2	0.839	1.125	3	0.771
Total number of friends (male)	3.517	2	0.172	3.320	3	0.345
Number of friends to share concerns (female)	1.370	2	0.504	0.601	3	0.896
Number of friends to share concerns (male)	3.254	2	0.196	0.014	3	1.000
Number of inspiring friends (female)	3.345	2	0.188	0.535	3	0.911
Number of inspiring friends (male)	0.590	2	0.744	5.944	3	0.114

Table 5-25 Employment situation

Variable	Happiness			Life Satisfaction		
	Chai^2	DF	Sig. Level	Chai^2	DF	Sig. Level
Wife – Type of payment	11.527	2	0.003	5.071	3	0.167
Wife - Paid overtime work (hour/week)	0.072	2	0.965	8.430	3	0.038
Wife - Unpaid overtime work (hour/week)	2.974	2	0.226	0.106	3	0.991
Wife - Working days (days/week)	5.571	2	0.062	1.584	3	0.663
Wife – Annual leave days entitled (days/year)	3.451	2	0.178	2.587	3	0.460
Wife – Annual leave days taken (days/year)	0.156	1	0.693	5.175	3	0.159
Husband – Type of contract	1.735	2	0.420	0.497	3	0.920
Husband - Paid overtime work (hour/week)	0.482	2	0.786	2.795	3	0.424
Husband - Unpaid overtime work (hour/week)	0.833	2	0.659	3.885	3	0.274
Husband - Working days (days/year)	2.482	2	0.289	4.579	3	0.205

Table 5-26 Household income from the previous year, household savings and stocks possession (10,000 Yen)

Variable	Happiness			Life Satisfaction		
	Chai^2	DF	Sig. Level	Chai^2	DF	Sig. Level
Total Household Income from the Previous Year	1.068	2	0.586	4.698	2	0.095
Total household savings and stocks possession	1.791	1	0.181	1.641	2	0.440

Table 5-27 Household income per family member (10,000 Yen)

Variable	Happiness			Life Satisfaction		
	Chai^2	DF	Sig. Level	Chai^2	DF	Sig. Level
Household income from the previous year (husband)	7.763	2	0.021	4.226	3	0.238
Household income from the previous year (wife)	5.018	2	0.081	0.844	3	0.839
Household income from the previous year (couple)	3.036	2	0.219	3.693	3	0.297
Household income from the previous year (other family member	3.976	2	0.137	3.700	2	0.157

Table 5-28 Household expenditure per person for the month of September (1,000 Yen)

Variable	Happiness			Life Satisfaction		
	Chai^2	DF	Sig. Level	Chai^2	DF	Sig. Level
Family in General	1.276	2	0.528	9.855	3	0.020
Wife	0.988	2	0.610	5.457	3	0.141
Husband	2.448	2	0.294	1.911	3	0.591
Child(ren)	3.962	2	0.138	1.192	3	0.755
Other	2.487	2	0.288	1.764	3	0.623

Table 5-29 Household spending allocation for the month of September (1,000 Yen)

Variable	Happiness			Life Satisfaction		
	Chai^2	DF	Sig. Level	Chai^2	DF	Sig. Level
Food	4.780	2	0.092	18.862	3	0.000
Housing (Rent/Mortgage)	0.806	2	0.668	0.987	3	0.804
Water, Gas, Electricity	0.567	2	0.753	2.433	3	0.487
Furniture and Household Appliances	0.165	2	0.921	0.654	3	0.884
Clothing and Shoes	0.654	2	0.721	6.456	3	0.091
Medical and Insurance	0.485	2	0.785	1.309	3	0.727
Transportation	2.122	2	0.346	1.042	3	0.791
Communication	0.983	2	0.612	7.308	3	0.063
Education	2.465	2	0.292	0.201	3	0.977
Hobby and Leisure	0.030	2	0.985	1.667	3	0.644
Going out	1.353	2	0.508	2.895	3	0.408
Allowances	3.136	2	0.208	4.153	3	0.245

Table 5-30 Housing and loan situation

Variable	Happiness			Life Satisfaction		
	Chai^2	DF	Sig. Level	Chai^2	DF	Sig. Level
Mortgage / rent (1,000 Yen)	0.319	2	0.853	2.678	2	0.262
Property Area (m^2)	1.338	2	0.512	2.056	2	0.358
Total due balance of Loan (10,000 Yen)	3.002	2	0.223	5.459	3	0.141
Total payment made last year (10,000 Yen)	0.900	2	0.638	3.413	3	0.332
Total due balance of Loans (10,000 Yen)	0.781	2	0.677	1.413	2	0.493
Total payment made last year (10,000 Yen)	3.682	2	0.159	1.690	2	0.429
New loan committed last year	4.324	2	0.115	0.713	2	0.700
The due balance of the new loan	5.023	2	0.081	2.999	2	0.223

Table 5-31 Household possession of durable consumer good

Variable	Happiness			Life Satisfaction		
	Chai^2	**DF**	**Sig. Level**	**Chai^2**	**DF**	**Sig. Level**
Dining Set	1.828	2	0.401	2.776	3	0.427
Cupboard	0.219	2	0.896	0.790	3	0.852
Microwave	0.186	2	0.911	0.210	3	0.976
Refrigerator	2.483	2	0.289	0.976	3	0.807
Automatic Dishwasher	0.099	2	0.952	0.309	3	0.958
Vacuum cleaner	0.069	2	0.966	2.944	3	0.400
Laundry machine	1.131	2	0.568	0.110	3	0.991
Cloths Dryer	0.225	2	0.894	7.101	3	0.069
Sewing machine	3.615	2	0.164	0.060	3	0.996
Electric Fan	1.421	2	0.491	0.285	3	0.963
Air Conditioner	0.273	2	0.872	2.980	3	0.395
Fan Heater	1.636	2	0.441	1.373	3	0.712
“Kotatsu” heater	1.776	2	0.411	1.186	3	0.756
TV set	0.066	2	0.968	3.028	3	0.387
Stereo Sound system	3.779	2	0.151	1.173	3	0.759
CD Radio Cassette Recorder	0.614	2	0.736	0.304	3	0.959
VCR	1.413	2	0.493	2.570	3	0.463
Video Camera	1.771	2	0.413	0.470	3	0.925
Telephone	0.526	2	0.769	0.417	3	0.937
Bicycle	7.664	2	0.022	1.233	3	0.745
Car	0.682	2	0.711	5.387	3	0.146
TV Game	1.711	2	0.425	0.191	3	0.979
Word Processor	0.807	2	0.668	0.535	3	0.911
Personal computer	1.414	2	0.493	3.244	3	0.356
FAX	0.825	2	0.662	0.393	3	0.942
Mobile (Cellular) Phone	1.734	2	0.420	1.133	3	0.769

6. Summary of Findings and Further Research

A longitudinal panel dataset was used to identify the effects of life events and life situations, enabling and limiting factors the happiness and life satisfaction of young Japanese women. The Japanese Panel Survey of Consumers (JPSC) from the Institute for Research on Household Economics was chosen for this study because the dataset provides most of the necessary variables as well as consumption data, happiness and life satisfaction data, and necessary background data for the analysis of factors and driving forces for the consumers' behavioural and happiness changes. A focus was placed on the "state" and "change" of dependent variables to that of happiness and life satisfaction.

The followings are major findings and further research necessary:

1. Similar shapes were observed between the histograms of the happiness data and life satisfaction data. Moreover, similar shapes were observed between the distributions of matched-pair differences between 1998 and 1999 for happiness data and life satisfaction data. It suggests that happiness and life satisfaction are accepted by the respondents of the survey as a similar concept and aspects. However, results of the statistical analysis suggest that happiness and life satisfaction are different in tendencies. There is no tangible standard to differentiate between the two, but it was implied that happiness is more closely linked with the self interests and subjective. Life satisfaction, on the other hand, is more related to objective matters, such as possession of money and goods.

2. The numbers of significant variables to happiness and life satisfaction out of cross sectional data analysis was 62, and that of longitudinal data analysis is 22, suggesting that increased number of significant variables on happiness and life satisfaction are observed in "states" analysis compared to "changes" analysis.

3. The results of this module will be helpful to learn what factors must be considered when one thinks about new technologies and services that have potential to lead to sustainable consumption.

4. Further analysis is necessary to compare the effects of "adopting of sustainable consumption activities" to "ultimate utility" and the effects of "driving forces and limiting factors" to "ultimate utility", as shown in Figure 2-1. The elucidation of the associated factors behind the mechanisms of increase of decrease of ultimate utility may be helpful to better understand the logics of consumption rebound effects.

Table 5-32 Summary of the results of the analysis

Variable	Crosse Sectional Data Analysis		Longitudinal Data Analysis	
	Happiness	Life Satisfaction	Happiness	Life Satisfaction
Number of family members	X	X	X	X
Level of wealth	X	X	X	
Gave a birth	X	X	X	X
Loss by death		X		
Married and left family	X	X	X	
First child				X
Found a new job		X		
Changed job			X	
Started a new lesson/training	X			
Depression/other psychiatric symptoms			X	
Transferred				X
Vol. retirement or lost job		X		X
Business bankrupts				X
Depression or other psychiatric problems		X		
Credit card/loan-related trouble	X	X		
Others	X	X	X	X
Lost good relationships with other family members	X	X	X	
Depression	X	X		
Others			X	
Number of inspiring friends (female)	X			
Wife – Employment situation			X	
Wife – Type of contract	X			X
Wife – Type of payment	X	X		
Wife - Paid overtime work (hour/week)	X			
Wife - Working days (days/week)	X	X		
Wife – Annual leave taken	X	X		
Husband - Paid overtime work (hour/week)	X	X		
Husband - Unpaid overtime work (hour/week)	X			
Husband - Working days (days/week)	X	X		
Total Household Income from the Previous Year	X			
Total Household Savings and Stocks Possession	X			
Household income from the previous year (husband)			X	
Family in General		X		X
Food	X			X
Clothing and Shoes	X			
Education		X		
Type of Housing	X	X		
How to make payment	X	X		
Degree of the burden of housing loan	X	X		
Degree of the burden of the loan other than housing loan	X	X		
Dining Set		X		
Cupboard	X	X		
Laundry machine	X			
Cloths Dryer		X		
Sewing machine		X		
“Kotatsu” heater		X		
Stereo Sound system		X		
VCR		X		
Telephone		X		
Bicycle			X	
TV Game		X		
Word Processor		X		
Mobile (Cellular) Phone		X		
Total Number of significant variables	**28**	**34**	**12**	**10**

7. Literature Cited

[4] William Mendenhall and Terry Sincich. *Statistics for Engineering and the Sciences.* 3rd Edition. Dellen Publishing Company, a division of Macmillan, Inc. U.S.A. 1992.

ANNEX: The Results form the Multiple Categorical Linear Regression Analysis on Happiness and Life-satisfaction

The followings tables are the outputs of the multiple categorical linear regression analysis on happiness and life-satisfaction performed with using SPSS 12.0J for this study. Only Beta values and observed significant levels (S.L.) are shown in the results section in the text. The flowing output data will be helpful to extend the understanding of the results as well as he statistical procedure.

A. Happiness

1. Basic variables

Summary of Cases

Effective Case	4542
Missing Case	18
Assisting Case	0
Total	4560
Cases used for the analysis	4542

Summary of Model

Multiple R	R2	Modified R2
.296	.088	.087

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	398.220	5	79.644	87.183	.000
Residual	4143.780	4536	.914		
Total	4542.000	4541			

Coefficient

	Normalized Coefficient				
	Beta	Standard error	DF	F	Observed significant level
Number of family members	.058	.014	1	16.946	.000
Level of wealth	.294	.014	4	427.366	.000

2. Life changes in member of family members

Summary of Cases

Effective Case	4151
Missing Case	409
Assisting Case	0
Total	4560
Cases used for the analysis	4151

Summary of Model

Multiple R	R2	Modified R2
.131	.017	.014

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	70.924	12	5.910	5.994	.000
Residual	4080.076	4138	.986		
Total	4151.000	4150			

Coefficient

	Normalized Coefficient				
	Beta	Standard error	DF	F	Observed significant level
Gave a birth	.098	.015	1	40.645	.000
Took parent(s) along home	-.002	.015	1	.010	.921
Return of a family member	-.004	.015	1	.058	.809
Increase for other reason	.005	.015	1	.124	.725
A family member transferred	-.009	.015	1	.373	.541
A family member moved out	-.010	.015	1	.426	.514
Loss by death	-.007	.015	1	.210	.647
Loss for other reason	-.021	.015	1	1.786	.181
Married and left family	.073	.015	1	22.415	.000
Divorced or separated	-.022	.016	1	1.881	.170
Left for an independent life	-.001	.015	1	.008	.928
Started to live with parents	-.009	.016	1	.299	.584

3. Happenings to self

Summary of Cases

Effective Case	285
Missing Case	4275
Assisting Case	0
Total	4560
Cases used for the analysis	285

Summary of Model

Multiple R	R2	Modified R2
.197	.039	.004

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	11.097	10	1.110	1.110	.354
Residual	273.903	274	1.000		
Total	285.000	284			

Coefficient

	Normalized Coefficient				
	Beta	Standard error	DF	F	Observed significant level
First Child	.039	.064	1	.367	.545
Found a new job	.039	.064	1	.367	.545
Changed job	.018	.060	1	.084	.772
Quit job	-.015	.060	1	.067	.796
Started a new lesson/training	-.024	.062	1	.147	.702
Took a leadership of a committee or organization	.058	.062	1	.868	.352
Illness requiring an operation or hospitalization	-.145	.061	1	5.599	.019
Depression/other psychiatric symptoms	-.052	.061	1	.718	.398
Loan/credit card related trouble	.055	.062	1	.807	.370
Accident/disaster	.081	.060	1	1.809	.180
Other	-.027	.061	1	.190	.663

4. Accidents, disasters, and consumer troubles

Summary of Cases

Applicable Active Case	143
Active case with missing values	4417
Assisting case	0
Total	4560
Cases used for the analysis	143

Summary of Model

Multiple R	R2	Modified R2
.304	.092	.045

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	13.189	7	1.884	1.959	.065
Residual	129.811	135	.962		
Total	143.000	142			

Coefficient

	Normalized Coefficient				Observed significant level
	Beta	Standard error	DF	F	
Traffic accidents	.138	.292	1	.223	.638
Fire	.012	.110	1	.012	.913
Accidents while at work	-.190	.122	1	2.415	.123
Burglary or theft	.202	.209	1	.930	.337
Suffering from products	-.004	.115	1	.001	.974
Bankruptcy	.058	.163	1	.127	.722
Other	-.081	.160	1	.258	.612

5. Happenings involving family

Summary of Cases

Effective Case	4130
Missing Case	430
Assisting Case	0
Total	4560
Cases used for the analysis	4130

Summary of Model

Multiple R	R2	Modified R2
.118	.014	.012

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	57.973	9	6.441	6.517	.000
Residual	4072.027	4120	.988		
Total	4130.000	4129			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Transferred	.025	.016	1	2.525	.112
Vol. retirement or lost job	-.001	.016	1	.006	.939
Business bankrupts	.010	.016	1	.434	.510
Illness requiring hospitalization or operation	-.011	.015	1	.525	.469
Depression or other psychiatric problems	-.004	.016	1	.064	.800
Credit card/loan-related trouble	-.090	.016	1	32.985	.000
Accident/disaster	-.023	.016	1	2.173	.141
Entrance exam and enrollment	.008	.015	1	.238	.626
Others	-.065	.016	1	17.364	.000

6. Life changes

Summary of Cases

Effective Case	1074
Missing Case	3486
Assisting Case	0
Total	4560
Cases used for the analysis	1074

Summary of Model

Multiple R	R2	Modified R2
.268	.072	.066

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	77.074	7	11.011	11.774	.000
Residual	996.926	1066	.935		
Total	1074.000	1073			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Big expenditure	-.005	.030	1	.031	.860
Income cut or depreciation of properties	-.040	.030	1	1.748	.186
Heavy burden on taking care	.055	.030	1	3.300	.070
Lost good relationships with other family members	-.195	.032	1	38.354	.000
Depression	-.118	.032	1	13.572	.000
Devoiced or separated	.051	.030	1	2.917	.088
Others	.016	.030	1	.292	.589

7. Number of friends

Summary of Cases

Effective Case	135
Missing Case	4425
Assisting Case	0
Total	4560
Cases used for the analysis	135

Summary of Model

Multiple R	R2	Modified R2
.354	.126	.085

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	16.947	6	2.824	3.062	.008
Residual	118.053	128	.922		
Total	135.000	134			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Total number of friends (female)	-.093	.157	1	.351	.555
Total number of friends (male)	-.074	.155	1	.231	.632
Number of friends to share concerns (female)	-.001	.140	1	.000	.996
Number of friends to share concerns (male)	.114	.115	1	.982	.324
Number of inspiring friends (female)	-.348	.156	1	4.977	.027
Number of inspiring friends (male)	.075	.148	1	.255	.614

8. Employment situation

Summary of Cases

Effective Case	537
Missing Case	4023
Assisting Case	0
Total	4560
Cases used for the analysis	537

Summary of Model

Multiple R	R2	Modified R2
.330	.109	.056

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	58.634	30	1.954	2.067	.001
Residual	478.366	506	.945		
Total	537.000	536			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Wife – Employment situation	-.052	.044	1	1.405	.236
Wife – Type of contract	.226	.059	2	14.933	.000
Wife – Type of payment	-.104	.059	2	3.052	.048
Wife - Paid overtime work (hour/week)	.098	.042	2	5.407	.005
Wife - Unpaid overtime work (hour/week)	.012	.045	1	.072	.789
Wife - Working days (days/week)	.117	.044	3	6.993	.000
Wife – Annual leave days	.068	.046	5	2.158	.057
Wife – Annual leave taken	.112	.045	6	6.248	.000
Husband – Type of contract	.077	.048	1	2.607	.107
Husband – Type of payment	.064	.050	1	1.675	.196
Husband - Paid overtime work (hour/week)	.106	.042	2	6.276	.002
Husband - Unpaid overtime work (hour/week)	.080	.043	2	3.441	.033
Husband - Working days (days/week)	.115	.044	2	6.793	.001

9. Household income from the previous year, household savings and stocks possession (10,000 Yen)

Summary of Cases

Effective Case	340
Missing Case	4220
Assisting Case	0
Total	4560
Cases used for the analysis	340

Summary of Model

Multiple R	R2	Modified R2
.193	.037	.032

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	12.657	2	6.328	6.515	.002
Residual	327.343	337	.971		
Total	340.000	339			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Total Household Income from the Previous Year	.207	.060	1	11.982	.001
Total Household Savings and Stocks Possession	-.148	.060	1	6.100	.014

10. Household income per family member (10,000 Yen)

Summary of Cases

Effective Case	13
Missing Case	4547
Assisting Case	0
Total	4560
Cases used for the analysis	13

Summary of Model

Multiple R	R2	Modified R2
.627	.394	.090

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	5.116	4	1.279	1.298	.348
Residual	7.884	8	.985		
Total	13.000	12			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Household income from the previous year (husband)	.199	.407	1	.240	.637
Household income from the previous year (wife)	.152	.452	1	.114	.745
Household income from the previous year (couple)	.501	.331	1	2.285	.169
Household income from the previous year (other family member	-.524	.349	1	2.252	.172

11. Household expenditure per person for the month of September (1,000 Yen)

Summary of Cases

Effective Case	735
Missing Case	3825
Assisting Case	0
Total	4560
Cases used for the analysis	735

Summary of Model

Multiple R	R2	Modified R2
.082	.007	.000

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	4.904	5	.981	.979	.429
Residual	730.096	729	1.002		
Total	735.000	734			

Coefficient

	Normalized Coefficient				
	Beta	Standard error	DF	F	Observed significant level
Family in General	-.052	.038	1	1.936	.165
Wife	.067	.039	1	2.950	.086
Husband	.005	.038	1	.017	.895
Child(ren)	-.004	.039	1	.010	.921
Other	-.002	.037	1	.002	.963

12. Household spending allocation for the month of September (1,000 Yen)

Summary of Cases

Effective Case	101
Missing Case	4459
Assisting Case	0
Total	4560
Cases used for the analysis	101

Summary of Model

Multiple R	R2	Modified R2
.452	.204	.096

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	20.628	12	1.719	1.882	.047
Residual	80.372	88	.913		
Total	101.000	100			

Coefficient

	Normalized Coefficient				
	Beta	Standard error	DF	F	Observed significant level
Food	.294	.113	1	6.773	.011
Housing (Rent/Mortgage)	.000	.102	1	.000	.999
Water, Gas, Electricity	.033	.117	1	.077	.781
Furniture and Household Appliances	.009	.098	1	.008	.929
Clothing and Shoes	-.244	.101	1	5.874	.017
Medical and Insurance	.020	.101	1	.041	.841
Transportation	.098	.104	1	.885	.349
Communication	.132	.141	1	.879	.351
Education	.056	.126	1	.200	.656
Hobby and Leisure	.119	.099	1	1.442	.233
Going out	-.120	.113	1	1.122	.292
Allowances	-.222	.121	1	3.375	.070

13. Housing situation

Summary of Cases

Effective Case	458
Missing Case	4102
Assisting Case	0
Total	4560
Cases used for the analysis	458

Summary of Model

Multiple R	R2	Modified R2
.395	.156	.136

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	71.619	11	6.511	7.515	.000
Residual	386.381	446	.866		
Total	458.000	457			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Property Area (m^2)	-.077	.044	1	3.025	.083
Total payment made last year (10,000 Yen)	-.072	.045	1	2.517	.113
Total due balance of Loan (10,000 Yen)	.007	.046	1	.021	.884
Type of Housing	.119	.044	1	7.394	.007
How to make payment	.076	.045	3	2.867	.036
If there is any that household has	.071	.044	1	2.600	.108
Degree of the burden of housing loan	.366	.045	3	67.444	.000

14. Loans apart from housing

Summary of Cases

Effective Case	404
Missing Case	4156
Assisting Case	0
Total	4560
Cases used for the analysis	404

Summary of Model

Multiple R	R2	Modified R2
.239	.057	.043

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	23.107	6	3.851	4.014	.001
Residual	380.893	397	.959		
Total	404.000	403			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Total due balance of Loans (10,000 Yen)	.108	.058	1	3.496	.062
Total payment made last year (10,000 Yen)	-.050	.050	1	1.002	.317
New loan committed last year	-.044	.056	1	.625	.430
Degree of the burden of the loan other than housing loan	.206	.051	3	16.326	.000

15. Household possession of durable consumer good

Summary of Cases

Effective Case	29
Missing Case	4531
Assisting Case	0
Total	4560
Cases used for the analysis	29

Summary of Model

Multiple R	R2	Modified R2
.988	.976	.864

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	28.295	23	1.230	8.730	.012
Residual	.705	5	.141		
Total	29.000	28			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Dining Set	.696	.571	1	1.485	.277
Cupboard	1.102	.274	1	16.219	.010
Microwave	-.983	.559	1	3.097	.139
Refrigerator	.087	.272	1	.101	.763
Laundry machine	-.922	.336	1	7.509	.041
Cloths Dryer	-.203	.164	1	1.523	.272
Sewing machine	.170	.187	1	.826	.405
Electric Fan	.258	.190	1	1.850	.232
Air Conditioner	-.171	.308	1	.308	.603
Fan Heater	-.098	.226	1	.189	.682
“Kotatsu” heater	.485	.295	1	2.705	.161
TV set	-.614	.651	1	.891	.389
Stereo Sound system	.327	.378	1	.746	.427
CD Radio Cassette Recorder	-.252	.204	1	1.536	.270
VCR	.270	.137	1	3.877	.106
Video Camera	.591	.285	1	4.299	.093
Telephone	.019	.119	1	.025	.880
Bicycle	.234	.109	1	4.626	.084
Car	-.126	.189	1	.444	.535
TV Game	-.349	.157	1	4.915	.077
Word Processor	.156	.110	1	1.998	.217
Personal computer	.129	.151	1	.733	.431
Mobile (Cellular) Phone	-.009	.153	1	.003	.957

B. Life Satisfaction

1. Basic variables

Summary of Cases

Effective Case	4542
Missing Case	18
Assisting Case	0
Total	4560
Cases used for the analysis	4542

Summary of Model

Multiple R	R2	Modified R2
.404	.163	.162

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	741.612	5	148.322	177.032	.000
Residual	3800.388	4536	.838		
Total	4542.000	4541			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Number of family members	.069	.014	1	25.556	.000
Level of wealth	.402	.014	4	873.999	.000

2. Life changes in member of family members

Summary of Cases

Effective Case	4149
Missing Case	411
Assisting Case	0
Total	4560
Cases used for the analysis	4149

Summary of Model

Multiple R	R2	Modified R2
.099	.010	.007

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	40.913	12	3.409	3.433	.000
Residual	4108.087	4136	.993		
Total	4149.000	4148			

Coefficient

	Normalized Coefficient				
	Beta	Standard error	DF	F	Observed significant level
Gave a birth	.047	.015	1	9.043	.003
Took parent(s) along home	.000	.016	1	.001	.981
Return of a family member	-.014	.016	1	.866	.352
Increase for other reason	-.007	.016	1	.201	.654
A family member transferred	-.025	.016	1	2.611	.106
A family member moved out	.013	.015	1	.707	.401
Loss by death	-.034	.015	1	4.913	.027
Loss for other reason	.016	.016	1	1.041	.308
Married and left family	.064	.016	1	16.959	.000
Divorced or separated	-.012	.016	1	.583	.445
Left for an independent life	.020	.015	1	1.630	.202
Started to live with parents	-.018	.016	1	1.254	.263

3. Happenings to self

Summary of Cases

Effective Case	285
Missing Case	4275
Assisting Case	0
Total	4560
Cases used for the analysis	285

Summary of Model

Multiple R	R2	Modified R2
.266	.071	.034

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	20.239	11	1.840	1.897	.040
Residual	264.761	273	.970		
Total	285.000	284			

Coefficient

	Normalized Coefficient				Observed significant level
	Beta	Standard error	DF	F	
First child	.080	.062	2	1.628	.198
Found a new job	-.226	.060	1	14.398	.000
Changed job	.039	.059	1	.447	.504
Quit job	-.075	.061	1	1.526	.218
Enrolled to a (graduate or professional) school	-.029	.061	1	.223	.637
Started a new lesson/training	-.042	.061	1	.478	.490
Illness requiring an operation or hospitalization	-.034	.060	1	.313	.576
Depression/other psychiatric symptoms	-.044	.061	1	.521	.471
Accident/disaster	-.029	.059	1	.239	.625
Other	.038	.059	1	.403	.526

4. Accidents, disasters, and consumer troubles

Summary of Cases

Effective Case	143
Missing Case	4417
Assisting Case	0
Total	4560
Cases used for the analysis	143

Summary of Model

Multiple R	R2	Modified R2
.255	.065	.017

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	9.325	7	1.332	1.345	.234
Residual	133.675	135	.990		
Total	143.000	142			

Coefficient

	Normalized Coefficient				Observed significant level
	Beta	Standard error	DF	F	
Traffic accidents	.208	.297	1	.491	.485
Fire	.057	.112	1	.257	.613
Accidents while at work	-.099	.124	1	.634	.427
Burglary or theft	.059	.212	1	.077	.782
Suffering from products	.068	.117	1	.336	.563
Bankruptcy	.115	.165	1	.486	.487
Other	-.078	.163	1	.231	.632

5. Happenings involving family

Summary of Cases

Effective Case	4128
Missing Case	432
Assisting Case	0
Total	4560
Cases used for the analysis	4128

Summary of Model

Multiple R	R2	Modified R2
.116	.014	.011

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	55.929	9	6.214	6.284	.000
Residual	4072.071	4118	.989		
Total	4128.000	4127			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Transferred	.011	.016	1	.546	.460
Vol. retirement or lost job	-.052	.016	1	11.137	.001
Business bankrupts	-.010	.016	1	.430	.512
Illness requiring hospitalization or operation	-.005	.016	1	.097	.756
Depression or other psychiatric problems	-.048	.016	1	9.259	.002
Credit card/loan-related trouble	-.055	.016	1	12.284	.000
Accident/disaster	.000	.016	1	.000	.993
Entrance exam and enrollment	.003	.015	1	.038	.845
Others	-.057	.016	1	13.297	.000

6. Life changes

Summary of Cases

Effective Case	1070
Missing Case	3490
Assisting Case	0
Total	4560
Cases used for the analysis	1070

Summary of Model

Multiple R	R2	Modified R2
.287	.083	.076

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	88.318	7	12.617	13.649	.000
Residual	981.682	1062	.924		
Total	1070.000	1069			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Big expenditure	-.039	.030	1	1.744	.187
Income cut or depreciation of properties	-.112	.030	1	13.631	.000
Heavy burden on taking care	.005	.030	1	.030	.862
Lost good relationships with other family members	-.137	.031	1	18.895	.000
Depression	-.141	.032	1	19.427	.000
Devoiced or separated	-.046	.030	1	2.372	.124
Others	.018	.029	1	.364	.546

7. Number of friends

Summary of Cases

Effective Case	135
Missing Case	4425
Assisting Case	0
Total	4560
Cases used for the analysis	135

Summary of Model

Multiple R	R2	Modified R2
.289	.083	.040

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	11.247	6	1.874	1.939	.079
Residual	123.753	128	.967		
Total	135.000	134			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Total number of friends (female)	-.144	.161	1	.792	.375
Total number of friends (male)	.114	.158	1	.519	.473
Number of friends to share concerns (female)	.096	.144	1	.447	.505
Number of friends to share concerns (male)	.024	.118	1	.042	.838
Number of inspiring friends (female)	-.238	.160	1	2.227	.138
Number of inspiring friends (male)	-.113	.152	1	.553	.459

8. Employment situation

Summary of Cases

Effective Case	534
Missing Case	4026
Assisting Case	0
Total	4560
Cases used for the analysis	534

Summary of Model

Multiple R	R2	Modified R2
.459	.211	.156

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	112.653	35	3.219	3.804	.000
Residual	421.347	498	.846		
Total	534.000	533			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Wife – Employment situation	.021	.043	1	.236	.628
Wife – Type of contract	.055	.054	2	1.025	.359
Wife – Type of payment	-.147	.055	2	7.194	.001
Wife - Paid overtime work (hour/week)	.013	.041	3	.107	.956
Wife - Unpaid overtime work (hour/week)	.131	.041	2	10.237	.000
Wife - Working days (days/week)	.125	.042	4	9.009	.000
Wife – Annual leave days	-.181	.052	8	12.214	.000
Wife – Annual leave taken	.256	.043	5	34.589	.000
Husband – Type of contract	-.295	.053	1	30.644	.000
Husband – Type of payment	.026	.041	1	.381	.537
Husband - Paid overtime work (hour/week)	-.081	.041	3	3.907	.009
Husband - Unpaid overtime work (hour/week)	.007	.040	1	.027	.869
Husband - Working days (days/week)	-.427	.054	2	63.445	.000

9. Household income from the previous year, household savings and stocks possession (10,000 Yen)

Summary of Cases

Effective Case	339
Missing Case	4221
Assisting Case	0
Total	4560
Cases used for the analysis	339

Summary of Model

Multiple R	R2	Modified R2
.104	.011	.005

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	3.632	2	1.816	1.820	.164
Residual	335.368	336	.998		
Total	339.000	338			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Total Household Income from the Previous Year	-.112	.061	1	3.385	.067
Total Household Savings and Stocks Possession	.023	.061	1	.145	.704

10. Household income per family member (10,000 Yen)

Summary of Cases

Effective Case	13
Missing Case	4547
Assisting Case	0
Total	4560
Cases used for the analysis	13

Summary of Model

Multiple R	R2	Modified R2
.656	.430	.145

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	5.586	4	1.396	1.507	.288
Residual	7.414	8	.927		
Total	13.000	12			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Household income from the previous year (husband)	-.388	.394	1	.971	.353
Household income from the previous year (wife)	.016	.438	1	.001	.971
Household income from the previous year (couple)	-.056	.321	1	.031	.866
Household income from the previous year (other family member	-.405	.339	1	1.432	.266

11. Household expenditure per person for the month of September (1,000 Yen)

Summary of Cases

Effective Case	732
Missing Case	3828
Assisting Case	0
Total	4560
Cases used for the analysis	732

Summary of Model

Multiple R	R2	Modified R2
.100	.010	.003

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	7.354	5	1.471	1.474	.196
Residual	724.646	726	.998		
Total	732.000	731			

Coefficient

	Normalized Coefficient				
	Beta	Standard error	DF	F	Observed significant level
Family in General	-.090	.038	1	5.741	.017
Wife	-.007	.039	1	.030	.862
Husband	-.003	.038	1	.008	.930
Child(ren)	-.009	.039	1	.049	.825
Other	-.032	.037	1	.747	.388

12. Household spending allocation for the month of September (1,000 Yen)

Summary of Cases

Effective Case	101
Missing Case	4459
Assisting Case	0
Total	4560
Cases used for the analysis	101

Summary of Model

Multiple R	R2	Modified R2
.510	.260	.160

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	26.300	12	2.192	2.582	.006
Residual	74.700	88	.849		
Total	101.000	100			

Coefficient

	Normalized Coefficient				
	Beta	Standard error	DF	F	Observed significant level
Food	.007	.109	1	.004	.949
Housing (Rent/Mortgage)	-.021	.099	1	.043	.836
Water, Gas, Electricity	.051	.113	1	.202	.654
Furniture and Household Appliances	-.041	.095	1	.188	.666
Clothing and Shoes	-.048	.097	1	.248	.620
Medical and Insurance	-.049	.097	1	.251	.618
Transportation	-.092	.100	1	.841	.362
Communication	.120	.136	1	.779	.380
Education	.377	.122	1	9.599	.003
Hobby and Leisure	.003	.096	1	.001	.975
Going out	-.019	.109	1	.030	.862
Allowances	.094	.117	1	.654	.421

13. Housing situation

Summary of Cases

Effective Case	456
Missing Case	4104
Assisting Case	0
Total	4560
Cases used for the analysis	456

Summary of Model

Multiple R	R2	Modified R2
.448	.201	.183

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	91.539	10	9.154	11.177	.000
Residual	364.461	445	.819		
Total	456.000	455			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Property Area (m^2)	-.020	.043	1	.216	.642
Total payment made last year (10,000 Yen)	-.069	.044	1	2.480	.116
Total due balance of Loan (10,000 Yen)	.013	.044	1	.086	.769
Type of Housing	.140	.043	1	10.763	.001
How to make payment	.155	.043	2	13.053	.000
If there is any that household has	-.056	.043	1	1.719	.190
Degree of the burden of housing loan	.372	.044	3	72.526	.000

14. Loans apart from housing

Summary of Cases

Effective Case	402
Missing Case	4158
Assisting Case	0
Total	4560
Cases used for the analysis	402

Summary of Model

Multiple R	R2	Modified R2
.323	.104	.091

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	41.940	6	6.990	7.668	.000
Residual	360.060	395	.912		
Total	402.000	401			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Total due balance of Loans (10,000 Yen)	-.006	.058	1	.010	.922
Total payment made last year (10,000 Yen)	-.033	.049	1	.438	.509
New loan committed last year	-.076	.055	1	1.909	.168
Degree of the burden of the loan other than housing loan	.332	.051	3	42.196	.000

15. Household possession of durable consumer good

Summary of Cases

Effective Case	29
Missing Case	4531
Assisting Case	0
Total	4560
Cases used for the analysis	29

Summary of Model

Multiple R	R2	Modified R2
.997	.995	.971

ANOVA

	Sum of squares	DF	Means Square	F	Observed significant level
Regression	28.848	23	1.254	41.295	.000
Residual	.152	5	.030		
Total	29.000	28			

Coefficient

	Normalized Coefficient		DF	F	Observed significant level
	Beta	Standard error			
Dining Set	1.016	.265	1	14.670	.012
Cupboard	.667	.127	1	27.537	.003
Microwave	-.267	.259	1	1.063	.350
Refrigerator	.297	.126	1	5.521	.066
Laundry machine	.102	.156	1	.428	.542
Cloths Dryer	-.615	.076	1	65.022	.000
Sewing machine	-.565	.087	1	42.517	.001
Electric Fan	.042	.088	1	.233	.650
Air Conditioner	.171	.143	1	1.423	.286
Fan Heater	-.102	.105	1	.945	.376
“Kotatsu” heater	-.377	.137	1	7.577	.040
TV set	.106	.302	1	.122	.741
Stereo Sound system	-1.479	.176	1	70.906	.000
CD Radio Cassette Recorder	.090	.095	1	.901	.386
VCR	.287	.064	1	20.372	.006
Video Camera	.143	.132	1	1.161	.331
Telephone	-.249	.055	1	20.478	.006
Bicycle	.062	.050	1	1.491	.277
Car	.026	.088	1	.091	.776
TV Game	-.217	.073	1	8.855	.031
Word Processor	.343	.051	1	44.741	.001
Personal computer	-.013	.070	1	.037	.855
Mobile (Cellular) Phone	.256	.071	1	12.954	.016

Appendix 4

Minimizing CO_2-emissions per unit of happiness

Patrick HOFSTETTER,
BAO (Büro für Analyse & Ökologie)
Oerlikonerstrasse 45, 8057 Zurich Switzerland
Phone +41 43 288 53 63; patrick_hofstetter@yahoo.com

Toshisuke OZAWA
National Institute of Advanced Industrial Science and Technology (AIST)
Research Center for Life Cycle Assessment
16-1 Onogawa, Tsukuba, Ibaraki 305-8569 JAPAN
Phone: +81-29-861-8107, FAX: +81-29-861-8118, t.ozawa@aist.go.jp

Abstract

Attempts to reduce CO_2-emissions per capita prove to show limited success – if at all. Especially approaches relying primarily on technological progress that increases the energy efficiency of services have often failed to materialize expected reductions in fossil fuel consumption. Such concepts need to be extended by considering two additional mechanisms: First, existing products or services are not just replaced by the new and more efficient alternative and second, consumers have no intrinsic motivation to reduce energy consumption but to maximize ultimate utility. Therefore, the needed methodology needs to model changes in consumption patterns and ultimate utility in order to predict CO_2 emission changes due to the introduction of new technologies or products. Using longitudinal panel data on household activities allows deriving consumption elasticities. These elasticities will be useful in predicting changes in consumption patterns. Changes in happiness and life satisfaction can be derived from the same data sample. Combining the activity-based calculation of life cycle CO_2 emissions calculated with a hybrid approach with information on change in consumption patterns and happiness allows identifying consumption activities with lowest CO_2 emissions per unit of happiness. These activities will be likely to escape the efficiency trap and actually deliver lasting reduction in CO_2 emissions per capita.

INTRODUCTION

It is well known that the energy efficiency of household appliances, cars, housing per square meter, producing steel, etc. has improved dramatically within the last 50 years. However, during the same period energy consumption and CO_2 emissions per capita went *up* and not down. Sustainable consumption requires drastic reductions of CO_2-emissions per capita in industrialized countries. Strategies are needed to achieve this reduction. Energy economics literature suggests that the mentioned efficiency gains are lost due to rebound effects (see Greene et al. 1999, Greening et al. 2000, and Binswanger 2001 for recent reviews). *Direct* rebound effects or pure price effect label the mechanism where higher energy efficiency reduces costs. Saved expenditures are reinvested in additional demand of the same service. Table 1 provides the order of magnitude of these rebound effects. E.g., if space heating is made more energy efficient, some people may either increase average heating temperature or heated space. This will – on average – eat up 10 to 30% of the initial savings. Thus, 70 to 90% of the "calculated" savings materialize when energy use for heating is looked at only. However,

Private Consumers	
Space heating	**10-30%**
Space cooling	**0-50%**
Water heating	**<10-40%**
Lighting	**5-12%**
Appliances	**0%**
Automative transport	**10-30%**
Firms	
Process uses (short-run)	**0-20%**
Lighting (short-run)	**0-2%**
Long-run aggregate impacts	**0-<100%**

Table 1 Review of Studies on Direct Rebound Effects (Greening et al. 2000)

there are additional possibilities to spend the saved money in other activities, e.g., a spring escape by plane or buying better insulated windows. This example illustrates that one needs to know what consequence single measures to save energy use have in order to evaluate the activities.

Apart from money, other limiting factors like, e.g., time, space, resources, information, and skills cause the change in a pattern rather than by a one time activity that could be evaluated in isolation. Rebound effects are not something "bad" per se but also offer potential for sustainable consumption. If a new activity uses lots of money, time, and space but causes little CO_2-emissions, it is likely that other activities that use as well money, time and space are ceased and the overall reduction caused by adoption of the new activity is much larger than its direct savings. Rather than a rebound this could be called a break out into new more sustainable circles.

Such activities that allow "break out's" are more likely adopted and sustained if consumers believe that their ultimate utility has increased. If this is not the case, other changes in activity and consumption patterns will occur.

Hofstetter & Madjar (2003) provide an analysis of the related phenomena around rebound effects and ultimate utility and suggest a new method to deal with both obstacles. This proposed method addresses two shortcomings:

1. Consumers rarely substitute ONE old consumption activity by ONE (and only one) new consumption activity. This yields to rebound effects that may turn the introduction of a new (seemingly) sustainable consumption activity into the reverse. Such behavioural changes in consumption are usually neglected.

2. LCA practitioner measure the utility of products and services often in units such as kg, meters, square meters, or piece and economists often use willingness to pay. However, consumers strive for ultimate utility that can be approximated with measures of quality of life and subjective well-being. We suggest that the acceptability of changes towards sustainable consumption patterns can be improved when ultimate utility increases. This would also avoid compensational consumption addressed in point 1 above.

In the next section the method development is explained in more detail and put into a more general framework. After this a short overview on the chosen approach including data source and expected results are given.

Equilibrium model on the micro level

General equilibrium models have rather similar goals to those described above. They allow to model, e.g., the effect on all other sectors if demand in one sector increases or decreases. These general equilibrium models are usually built on a macro level and build on a sector model of the economy. In addition to the technical coefficients known from Input-Output tables they also include elasticities that are supposed to reflect market reactions.

In order to evaluate specific activities of sustainable consumption we need a more disaggregated model. Therefore, we suggest building a model that could be described as a partial equilibrium model on the micro level that is linked to an extended input-output analysis. As described below we use longitudinal panel data to derive elasticities between activities. As described in Gershuny (2002) this may lead to insights such as that using the internet 10 minutes more per day will lead to 4 minutes less radio/TV/video, 2.5 minutes more going out, 2 minutes less visiting friends, 2 minutes

less sleep and so on. This is the elasticity analysis and the central element of the new approach.

A second element uses input-output analysis that has been extended by environmental data. These models are further extended by data of process analysis in order to assess not only the production but also the use and disposal phase of the life cycle of products and services. This element is used in our case to calculate CO_2-emissions due to a newly adopted activity *and* all affected other activities to the extent they will be influenced as shown from the partial equilibrium model above.

The third element measures the change in life satisfaction and happiness due to the shift in the consumption pattern. This data can be derived as well for longitudinal panel data.

Although these three elements could be integrated we will combine them manually in a transparent manner to avoid black boxes. The combination of the results will reveal net effects on CO_2-emissions and happiness due to the adoption of a new activity. This will tell us both: Which activities have potential to yield net CO_2 reductions and which of these activities will improve consumer happiness and therefore be likely to cause no other rebound effects.

The suggested modeling approach could – if sufficiently good longitudinal panel data is available – be used for the assessment of any activity. However, even more interesting would be to learn from these models what factors need to be considered when we think about new activities that have potential to lead to sustainable consumption. This is one reason we do not integrate the three described elements into a closed model. Nevertheless, even more explanatory variables could be introduced by adding information on limiting factors to the analysis. A very good candidate is time use data. If activities are looked at that reduce the size of products, space use may be another candidate to include. In most cases, new activities will differ in price. Therefore, costs could be included as well.

We stick to the most direct and elegant modeling approach that directly derives elasticities between activities because we are lacking good data on limiting factors in the used longitudinal panel data (see below).

Methods and Expected Results

The Japanese Panel Survey of Consumers (JPSC) data sets were provided from the Institute for Research on Household Economics (IRHE) of Japan. The JPSC longitudinal data include the variables of time-use, consumption and quality of life/life satisfaction necessary for our study. The panel cohort consists of 1,500 women from 24-34 years of age in 1993 and geographically distributed throughout the nation. The latest dataset available is from the survey in 1999. For this study, Toshisuke Ozawa, approved user of the JPSC data, performed statistical analysis using SPSS v.11.5J.

Four cases of introducing new technologies and products (new activities) such as: (1) automatic dishwasher use, (2) cloths dryer use, (3) personal computer use, and (4) mobile (cellular) phone use, have been chosen to be investigated. Estimating the effects of the above new activities by comparing the mean values of variables of adopters and non-adopters demonstrated by a single “cross-sectional” data may involve a logical error. Any differences found between adopters and non-adopters of a new activity my be a consequence of the activity itself or it may reflect some other prior differences between people that relates to their choosing to adopt the new activity. Therefore, the processes of changes can not be explored merely by examining differences between the group’s common attributes.

In this study, we analyze paired comparisons of variables between years 1997 and 1998, and 1998 and 1999, referring to the earlier year as "p" and the later as "q" as described in Gershuny (2002). Assuming that a person regularly uses the new product once purchasing it, we divided the cohort panel into four groups: Group NN, those that have access to the new activity in neither year; Group NY, those that started the new activity in year q; Group YY, those that have access in both years; and Group YN, those that had access in year p but not in q. We first make straightforward comparisons of changes in time-use, household consumption (expenditure), and happiness/life satisfaction among the above groups in paired years. It is expected that the results from the comparisons will help us to evaluate the genuine impact of adopting the new activity in one's life.

Changes in CO_2 emissions in linkage with consumption pattern are calculated via two-stage approach – using *National Survey of Family Income and Expenditure* data for the economic consumption per hour, and the *Input-Output Table* data for CO_2 emission per money unit, both published by the Statistics Bureau of Japan.

Conclusions

The proposed approach suggests to extend traditional life cycle assessment by adding two important elements: a partial equilibrium model to quantify shifts in consumption pattern rather than to stick to the unrealistic assumption that a new activity substitutes no or exactly one activity; and a tool to asses the change in happiness or life satisfaction due to the shift in consumption patterns. This yields both a better assessment of expected changes in CO_2-emissions and an indication on whether ultimate utility is improved or whether further shifts in consumption patterns may result. The implementation of the approach will have to prove these expected results and will clarify the nature and amount of needed data to use the approach on a routinely basis.

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