

Household Behavior and Environmental Policy :

Waste Generation

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1. Introduction

- ✓ Objectives are to examine ...
 1. Household Responses to waste policies ;
 2. The impact of socio-economic characteristics of household on waste generation
(e.g. income, age, household size, education, and etc.)

1. Introduction

- ✓ **Why we need to know household's waste generation behaviour**
- Government Intervention for waste prevention has been emphasized
 - to reduce demand for waste facility
 - to prevent environmental pollution from waste treatment
- It is important to know how households respond to waste policies in order to formulate efficient waste policy.
- Household responses are necessary to reduce waste generation.

2. Data and Descriptive Statistics of Variables

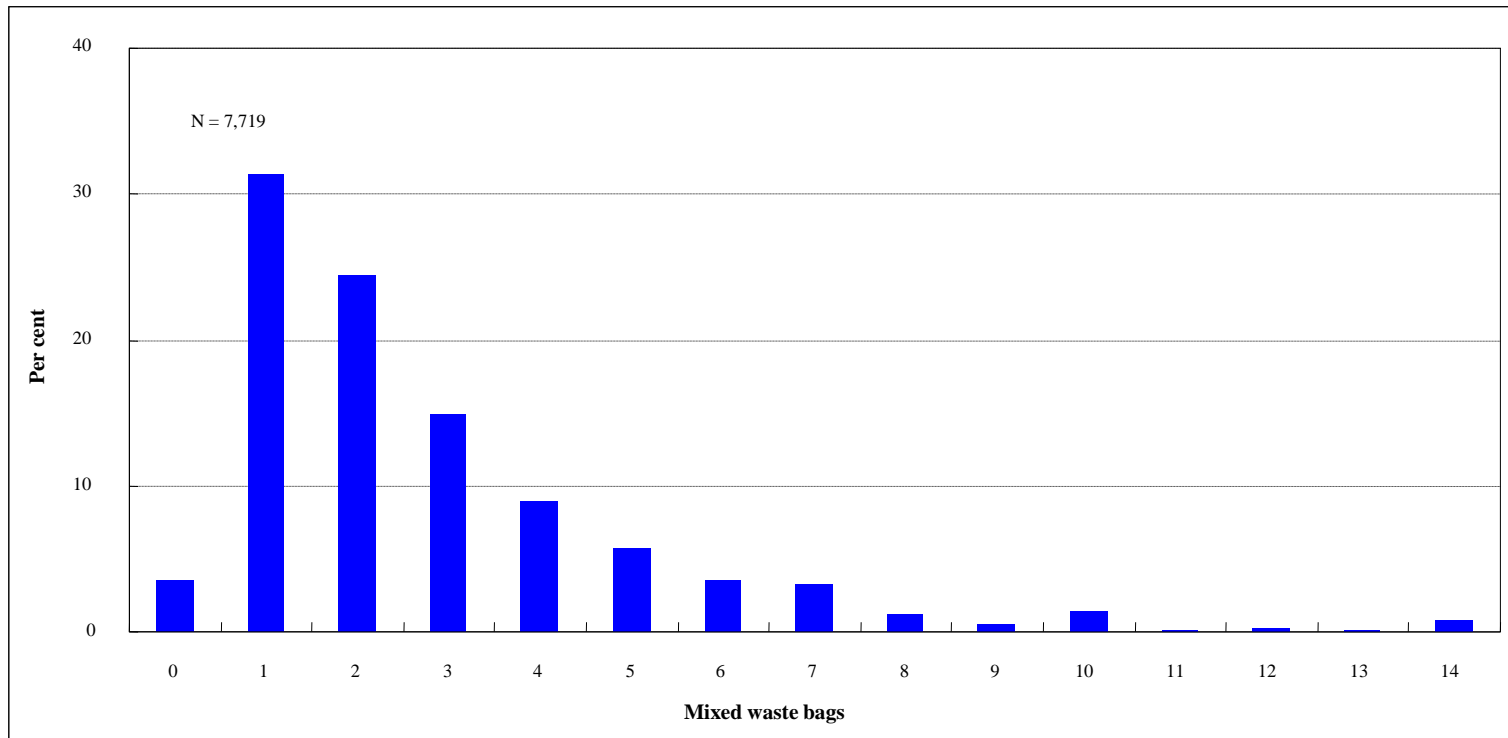
- The Survey developed by the Secretariat of the OECD Environment Directorate with inputs from ...
 - Advisory Committee,
 - Research teams in the project
 - Other OECD Directorates working in related areas (e.g. TAD, STI)
 - The International Energy Agency.
- Implementation : Internet panel-based survey
 - total 10,251 respondents
 - approximately 1000 observations per each country

2.1 Waste Generation Data

- Survey on mixed waste bag generation of 10 OECD countries
 - Large % of households generate one waste bag (31.4 %)
 - Next is two and three waste bags (24.5 % and 14.9 % respectively)
 - A household's average waste generation per week within 10 OECD countries 2.78 bags of a 20 liter bag (55.6 liters)
 - Each country generates one to three bags per week on average (70.8 % of respondents)
 - Distribution of Mixed waste bag generation has discrete value numbered 1,2,3

2.1 Waste Generation Data

- <figure> mixed waste bag generation in OECD(10)



2.1 Waste Generation Data

- <table 1> Summary statistics of waste Generation data

Country	Mixed waste bags							
	N	MEAN	STD	MIN	Q1	MEDIAN	Q3	MAX
OECD(10)	7719	2.78	2.34	0	1	2	4	14
Australia	640	3.16	2.19	0	2	3	4	14
Canada	726	1.84	1.29	0	1	2	2	14
Czech	499	2.56	1.95	0	1	2	3	14
France	829	2.50	1.93	0	1	2	3	14
Italy	1093	4.12	2.75	0	2	3	6	14
Korea	823	1.77	1.23	0	1	1	2	10
Mexico	715	4.04	2.86	0	2	3	5	14
Netherlands	795	2.16	1.64	0	1	2	3	14
Norway	840	1.53	1.60	0	1	1	2	14
Sweden	759	3.85	2.81	0	2	3	5	14

2.2 Independent Variables

- Personal attributes are
 1. marital status
 2. gender
 3. age group (18-24, 25-34, 35-44, 45-54)
 4. education level (no high school, high school or equivalent, college)
 5. employment status (full time, part time, retired, housewife, student)
- Household characteristics are
 1. number of adults
 2. number of children (under 5, 5-18)
 3. income
 4. home ownership
 5. type of house (detached house or apartment)
 6. number of rooms, existence of garden
 7. location (urban or rural)

2.2 Independent Variables

- Variables of attitude on environment are ^(ref.)
 1. environmental concern
 2. concern on waste generation
 3. environmental affiliation
 4. environmental concern index (environmental attitude index and environmental purchase index)
- Waste policy variables are
 1. unit pricing based on weight
 2. unit pricing based on volume
 3. unit pricing based on frequency
 4. Collection frequency : once a week / more than once a week.

2.2 Independent Variables(1)

	Variable names	
Personal Attributes	MARRIED (=1 if married or living as a couple, =0 otherwise)	
	MALE (=1 if male and =0 if female)	
	AGE 18-24 (=1 if between 18 and 24 years of age) AGE 25-34 (=1 if between 25 and 34 years of age) AGE 35-44 (=1 if between 35 and 44 years of age) AGE 45-54 (=1 if between 45 and 54 years of age)	
	NOHS (=1 if no high school); HS (= 1 if high school); SOMEPS(= 1 if some post-secondary education); BA (= 1 if Bachelor's Degree)	
	EMPLET (=1 if full time job); EMPLPT(=1 if part time job); RETIRED(=1 if retired); HWIFE (=1 if house husband/housewife); STUDENT(=1 if student)	
Household Attributes	ADULTS (Number of adults)	
	CHILDREN 5 (number of children under 5) CHILDREN 5 to18 (number of children between 5-18)	
	INCOME_CONT (income in Euros)	
	OWNERSHIP	
Residence Attributes	HOUSE (= 1 if a detached house; if a semi-detached / terraced house in a building with less than 12 apartments in total, if an apartment in a building with more than 12 apartments; =0 otherwise)	
	N_ROOMS (number of rooms)	
	GARDEN (= 1 if garden size is equal to 2,3,4,5,6)	11
	URBAN (= 1 if urban or suburban and =0 if isolated dwelling (not in a town or village) or rural).	

2.2 Independent Variables (2)

	Variable names
Environment Attribute	ENVRANK (= 1 to 6, 1 if environmental issues are more important than other issues)
	WGCONCERN (= 1 if fairly concerned, if concerned, if very concerned(=4) and =0 if not concerned(=1) or if no opinion),
	ENVCNCRN_INDX (= 0.03 to 4; concern for environmental issues)
	ENV_AFFI (= 1 if envmember=1(yes) and = 0 if envmember=2(no)); participation in environmental organizations
	ENVATTID_INDX(attitude to environment)
	ENVPURCH_INDX(purchase environmental goods)
Recycling Motives	BEBEFICIAL (beneficial for environment)
	MANDATED (mandated by government)
	SAVING (money saving from recycling)
	CIVIC (considered civil duty)
	RESPONSE (desire to be seen as a responsible citizen)
Policy Variables	FEE_WEIGHT (= 1 if unit pricing based on weight, =0 if else) FEE_VOLUME (= 1 if unit pricing based on volume, =0 if else) FEE_FREQUENCY(= 1 if unit pricing based on frequency, =0 if else)
	MIX_FREQMORE (= 1 if more than once a week pick up, =0 if otherwise) MIX_FREQONCE(= 1 if once a week pick up, =0 if otherwise).

2.3 Summary of Variables (1)

- Personal Attribute

	Variables	Mean(SD)
Marital status	Married	0.64 (0.48)
Gender	Male	0.51 (0.50)
Age	Age 18-24	0.12 (0.32)
	Age 25-34	0.20 (0.40)
	Age 35-44	0.22 (0.42)
	Age 45-54	0.20 (0.40)
Education	NOHS	0.12 (0.32)
	HS	0.26 (0.44)
	SOMEPS –some post secondary education	0.27 (0.44)
	BA	0.25 (0.44)
Employment	EMPLET- full time	0.50 (0.50)
	Emplpt – part time	0.12 (0.32)
	Retired	0.14 (0.35)
	Hwife	0.07 (0.25)
	Student	0.06 (0.25)
N		7719

2.3 Summary of Variables (2)

- The mean value of each variable indicates proportion
 - 64 % of respondents are married. country means of being married are within the range of 57% to 70% (Australia is the highest at 70%).
 - 51 % of respondents are male
 - the gender ratio (Male/Female) for the ten countries lies between 46 % and 55 % showing that Mexico and Norway is highest at 55% and Sweden is the lowest at 46 %
- Education level
 - 26 % of respondents are high school graduate
 - 27 % of respondents receive post-secondary education
 - 25 % of respondents hold bachelor's degree
 - Respondent of no high school education is 12 % on average but it varies among countries.
 - Respondents of bachelor's degree is 25 % on average sample but it is higher in Korea (43%), Mexico (50%) and it is lower in Czech Republic (4%), France (8%) compared with average OECD sample
- Employment status
 - Respondents in full-time employment are 50 %, with most countries in the same range
 - Part-time employment is 12 % and it is relatively lower in Czech Republic (2%) and France (7%).
 - Retired respondent is 14 % but is higher in France (28%), lower in Korea (3%) and Mexico (2%).

2.3 Summary of Variables (3)

- Summary statistics of Household attribute

Variables		Mean (SD)
Number of adults	Adults	2.23 (1.00)
Number of children	Children 5	0.19 (0.49)
	Children 5 to 18	0.45 (0.80)
Income	Income_cont (Euro)	31,174 (21,960)
House own	OWNERSHIP	0.68 (0.47)
House characteristics	HOUSE (type of house)	0.56 (0.50)
	N_rooms (number of rooms)	4.89 (2.27)
	Garden (presence of garden)	0.87 (0.34)
	Urban	0.75 (0.43)
N		7719

2.3 Summary of Variables (4)

- The number of adult in a household
 - 2.23 persons on average and Korea has the highest number of adults (2.90), and Sweden has the lowest number of adults (1.67) per household.
- The number of children under 5 years
 - 0.19 and number of children between 5 and 18 years is 0.45 per household.
- The mean income level
 - 31,174 euro/year, and Mexico has the lowest mean (6,886 euro) and Norway has the highest mean income (60,086 euro).
 - 68 % of respondents own their residence, with Italy having the highest percentage at 81 % and the Netherlands the lowest with 49%
- The types of housing
 - Mixture of Apartments
 - Detached House : Australia, Mexico and Norway (compare with other countries)
- The mean number of rooms in a residence
 - 4.89. Korea has the lowest mean number of rooms (3.48) and Canada has largest mean number of rooms (6.03).
 - The rate of household having a garden is 87 per cent and that of households living in an urban or suburban area is 75 per cent

2.3 Summary of Variables (5)

- Summary of Environmental Attitude

	Variables	Mean (SD)
Environmental rank	Envr_rank	3.35 (1.55)
Concern on waste generation	Wgconcern	0.94 (0.23)
	Envcnern_indx	3.04 (0.65)
Member of env. Group	Env_affi	0.16 (0.36)
Environmental attitude	Envattid_indx	0.43 (0.68)
	Envpurch_indx	2.89 (0.59)
	BENEFICIAL	0.97 (0.18)
Recycling Motives	MANDATED	0.40 (0.49)
	SAVING	0.46 (0.50)
	CIVIC	0.89 (0.31)
	RESPONSE	0.53 (0.50)
N		7719

- Index are generated following those of “Ida Ferrara”

2.3 Summary of Variables (6)

- The level of environmental concern
 - 3.35 and it is the highest in Mexico (3.56), Korea (3.3), Italy (3.19), France and Canada (3.07), and Australia (3.06)
- Concerns about waste generation
 - 0.94 on average and ranges between 0.85 in Sweden and 0.99 in Mexico indicating a very high level of concern for waste generation.
 - According to an index of environmental concern created, average respondents show very high concern on environmental issues since the index level is 3.04 out of 4. It ranges between 3.56 in Mexico and 2.59 in the Netherlands
- An environmental attitude index
 - 0.43 on average, with country means in the range of 0.69 (Czech Republic) and 0.21 (Italy)
- An environmental purchase index
 - The propensity of respondents to buy environmental goods
 - This index is 2.89 on average and lies in the range between 3.05 (Australia, Canada, and Mexico) and 2.61 (Norway) showing strong attitude to buy recycled goods.

2.3 Summary of Variables (7)

- Policy variables

	Variables	Mean (SD)
Pricing mechanism	Fee_weight (\$)	0.02 (0.15)
	Fee_volume (\$)	0.12 (0.33)
	Fee_frequency (\$)	0.04 (0.21)
Collection frequency	Mix_freqmore - more than once a week	0.36 (0.48)
	Mix_freqonce – once a week	0.45 (0.50)

- The percentage of households which face a frequency based fee is 4%,
- households for volume-based fee is 12 %.

3. Methodology

- The peak of the distribution (mode) does not correspond to the arithmetic mean and thus **Poisson distribution** has been assumed.
- A discrete random variable Y follows a Poisson distribution with parameter μ ($\mu > 0$) if it has a probability distribution as follows

$$f(Y) = \frac{\mu^Y e^{-\mu}}{Y!}, \quad Y = 0, 1, 2, 3, \dots$$

Where, $f(Y)$ is probability of Y

$$Y! = Y \cdot (Y - 1) \cdot \dots \cdot 3 \cdot 2 \cdot 1$$

The Poisson distribution has an expected mean value and variance as follows;

$$E(Y) = \mu$$

and $\sigma^2(Y) = \mu$

3. Methodology

- As the Number of Waste bag generated per week has typical Poisson distribution. Generalized linear models (GLM) to estimate this model can be written as follows;

$$Y_i = E(Y_i) + \varepsilon_i = \mu_i + \varepsilon_i \quad i = 1, 2, 3, \dots, n$$

If Number (Y) of Waste bag generated per week follows Poisson distribution and expected value

μ , explanatory variable X, Poisson log-linear model can be defined as follows:

$$\log(E(Y)) = \log(\mu) = \alpha + \beta X$$

Mean derived from this model satisfies following relationship:

$$\mu = \exp(\alpha + \beta X)$$

Log-likelihood function of this model is:

$$\log L = \sum_{i=1}^n Y_i (\alpha + \beta X) - \sum_{i=1}^n \exp(\alpha + \beta X) - \sum_{i=1}^n \log Y_i!$$

3. Methodology

✓ **Final estimation equation** is defined as follows:

$$\text{Waste } Q = a_1jX_1 + a_2jX_2 + a_3jX_3 + a_4jX_4 + a_5jX_5 + a_6jX_6 \text{ -----(1)}$$

Where, waste is number of waste bag generated per week by household

- X1 = Country dummy variables (9)
- X2 = Personal attribute variables
- X3 = Household attribute variables
- X4 = Environmental attitude variables
- X5 = Recycling motives
- X6 = Policy variables

a_{ij} =parameter estimates for all $i=1, \dots, 6$.

4. Estimation Results

✓ Summary

- Marital status (being married or living as a couple), Gender (male), Age 18-24, Fulltime employment, Retired and Student
 - Statistically significant and positive impact on Waste generation.
- Number of adults, Children under 5, Children 5-18, Household income, Number of rooms, Living in a urban/suburban area (Household Attributes)
 - statistically significant positive impact on waste generation
- Environmental attitude index, Purchasing power index of environmental good
 - significantly reduces waste generation

4. Estimation Results

✓ Summary

- The dummy variable whether a volume-based fee is present
 - a strong negative impact on waste generation.
- The frequency of waste collection
 - Positive impact on waste generation.
 - The more often collection service provided, the more waste generated.

4. 1 Country specific effect in Waste Generation

- Sweden is chosen as a reference country for comparison.
- Difference of each country's waste bag generation compared to Sweden is statistically significant at 1% level.
- The difference of waste bag generation in Korea compared to Sweden is calculated as follows

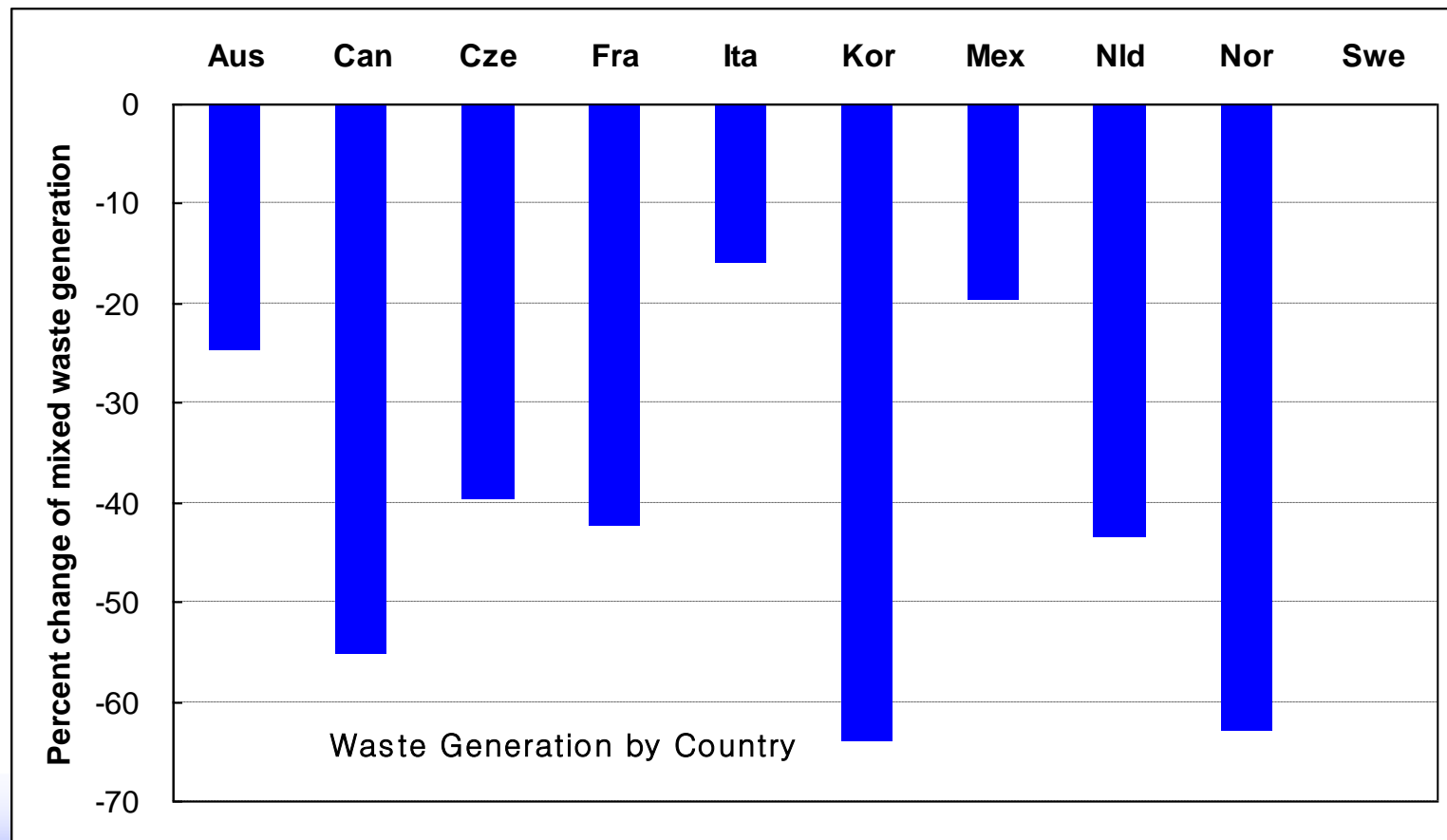
$$\frac{E(Y / Korea)}{E(Y / Sweden)} = \exp(-1.0199) = 0.3606$$

Ref> And $(1-0.3606)*100=63.9\%$

- The result shows Korea, Canada, Netherland are generates 40% - 64% less than Sweden does.

4. 1 Country specific effect in Waste Generation

- Waste Generation in 10 Countries



4.1 Country specific effect in Waste Generation

- Comparison of Poisson & Ordered Probit Estimation Result of Waste Generation
 - Ordered Probit : 3rd order <bag 1,2,3>

	Poisson				Order probit			
	Parameter	Coeff	p-value		Parameter	coeff	p-value	
	Intercept 1	0.9029	<.0001	***	Intercept 3	-0.6417	<.0001	***
					Intercept 2	0.1343	0.4114	
Country Dummy	Can	-0.8033	<.0001	***	Can	-1.2026	<.0001	***
	Nld	-0.5725	<.0001	***	Nld	-0.7937	<.0001	***
	Fra	-0.5529	<.0001	***	Fra	-0.8218	<.0001	***
	Mex	-0.2196	<.0001	***	Mex	-0.2544	0.0019	***
	Ita	-0.1735	<.0001	***	Ita	-0.1739	0.0122	**
	Czr	-0.5057	<.0001	***	Czr	-0.7668	<.0001	***
	Nor	-0.9934	<.0001	***	Nor	-1.7236	<.0001	***
	Aus	-0.2838	<.0001	***	Aus	-0.3163	<.0001	***
	Kor	-1.0199	<.0001	***	Kor	-1.4977	<.0001	***

- note: significance level * : 0.1, **:0.05, ***:0.01 and Income_cont. is coefficient of 10,000 euro units.
- This implies that each waste generation factor

4.2 Impact of personal attribute on Waste Generation

- Poisson & Ordered Probit Estimation Result of Waste Generation

Poisson				Order probit		
Parameter		Coeff		Parameter	coeff	
Intercept 1		0.9029	***	Intercept 3	-0.6417	***
				Intercept 2	0.1343	
Personal Attribute	Married	0.059	***	Married	0.0947	***
	Male	-0.0338	**	Male	0.00798	
	Age18-24	0.0897	***	Age 18-24	0.3115	***
	Age 25-34	0.0299		Age 25-34	0.176	***
	Age 35-44	-0.0212		Age 35-44	0.0509	
	Age 45-54	0.0054		Age 45-54	0.0784	*
	NOHS	0.0077		NOHS	0.0447	
	HS	0.0258		HS	0.0359	
	SOMEPS	0.0016		SOMEPS	-0.0116	
	BA	-0.0071		BA	-0.0567	
	EMPLET	0.0555	**	EMPLET	0.0446	
	Emplpt	0.0332		Emplpt	0.0265	
	Retired	0.1081	***	Retired	0.131	**

4. 2 Impact of Personal Attributes on Waste Generation

- Married or living as a couple
 - Significant and positive impact on waste generation
- Households with male respondents
 - Generate less waste than females
 - the coefficient indicating a difference of 3.32% ($\exp(-0.0338)=0.9668$ and $1- 0.9668=0.0332$) at 5% significance level
- The 55 year or older age group
 - respondents between 18 years and 24 years of age generate the most waste, with a value of 9.38 % more than the reference age group ($\exp(0.0897)=1.0938-1 = 9.38\%$)
- The impact of education level on waste generation
 - No statistical significance but a consistent positive sign among all 10 countries
- This employment status is grouped into three as full time, retired and student
 - Full time employer, retired, student generate 3.38 %, 11.42 % and 6.91 % more waste

4.3 Impact of Household attributes on Waste Generation

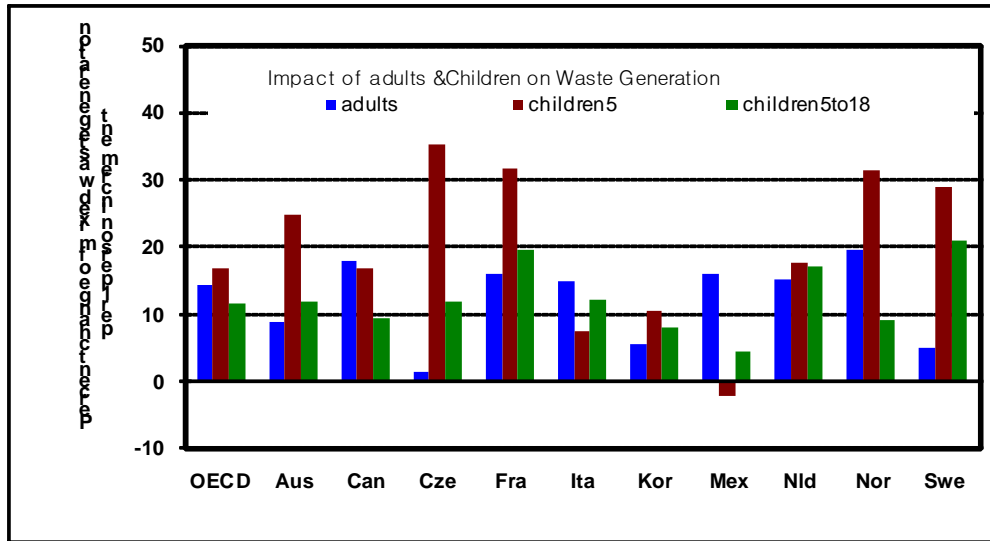
- Poisson & Ordered Probit Estimation Result of Waste Generation

	Poisson				Order probit			
	Parameter	Coeff	p-value		Parameter	coeff	p-value	
Household Attributes	Adults	0.1329	<.0001	***	Adults	0.2183	<.0001	***
	Children 5	0.154	<.0001	***	Children 5	0.3068	<.0001	***
	Children 5 to 18	0.1077	<.0001	***	Children 5 to18	0.1595	<.0001	***
	Income_cont	0.008	0.0647	*	Income_cont	0.0214	0.0151	**
	OWNERSHIP	-0.0226	0.1812		OWNERSHIP	-0.0242	0.4721	
	HOUSE	-0.0165	0.3531		HOUSE	-0.0257	0.462	
	N_rooms	0.0135	0.0003	***	N_rooms	0.0248	0.0019	***
	Garden	0.011	0.6213		Garden	-0.0207	0.6316	
	Urban	0.0867	<.0001	***	Urban	0.1277	0.0002	***

4. 3 Impact of Household Attributes on Waste Generation

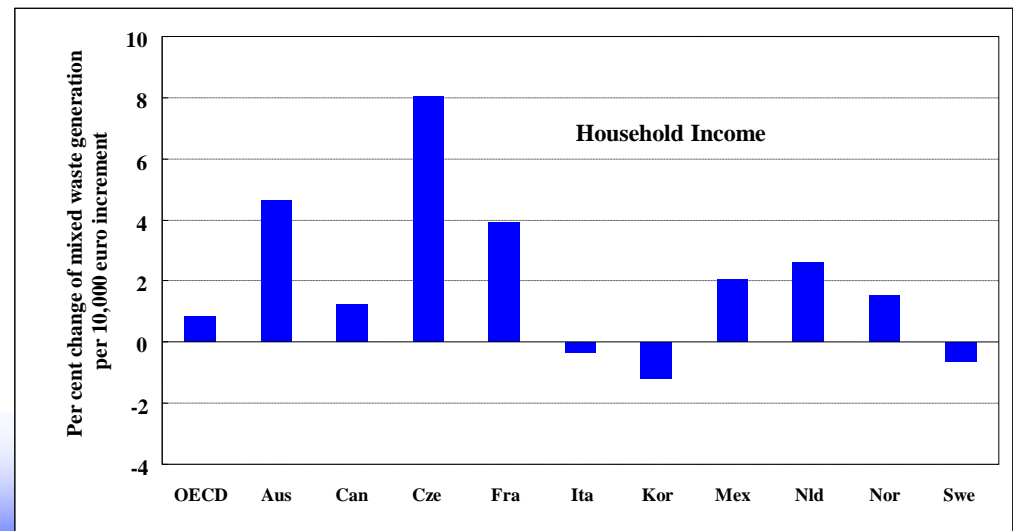
- Ownership of the residence
 - A negative impact on the generation of mixed waste
 - Its parameter estimate is not statistically significant.
- The number of rooms excluding bathroom
 - A positive and significant effect on waste generation at 1% level
- Household income
 - Increase waste generation
 - Its estimate is significant at 10% level.

4. 3 Impact of Household Attributes on Waste Generation



- Impact of adults & Children on Waste Generation

- Household Income effect on mixed waste generation by each country



4.4 Impact of Env. Attitude on Waste Generation

- Poisson & Ordered Probit Estimation Result of Waste Generation

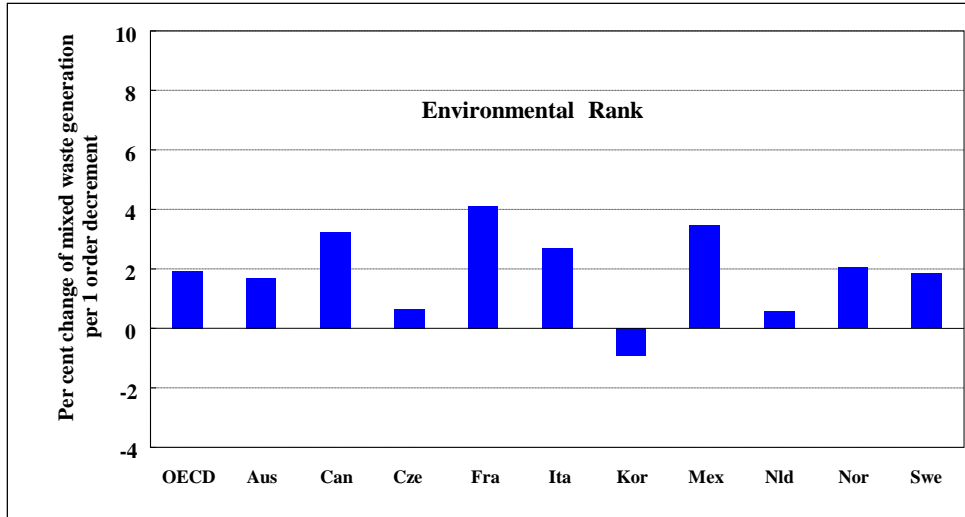
	Poisson				Order probit			
	Parameter	Coeff	p-value		Parameter	coeff	p-value	
Environmental Attitude	Envr_rank	0.0191	<.0001	***	Envr_rank	0.0405	<.0001	***
	Wgconcern	-0.0179	0.582		Wgconcern	-0.00007	0.9992	
	Envcnern_indx	0.0167	0.2399		Envcnern_indx	0.0128	0.6495	
	Env_affi	-0.0062	0.7542		Env_affi	0.0372	0.3467	
	Envattid_indx	-0.0351	0.0016	***	Envattid_indx	-0.0635	0.0045	***
	Envpurch_indx	-0.0831	<.0001	***	Envpurch_indx	-0.111	<.0001	***

4.4 Impact of Env. Attitude on Waste Generation

- Poisson & Ordered Probit Estimation Result of Waste Generation

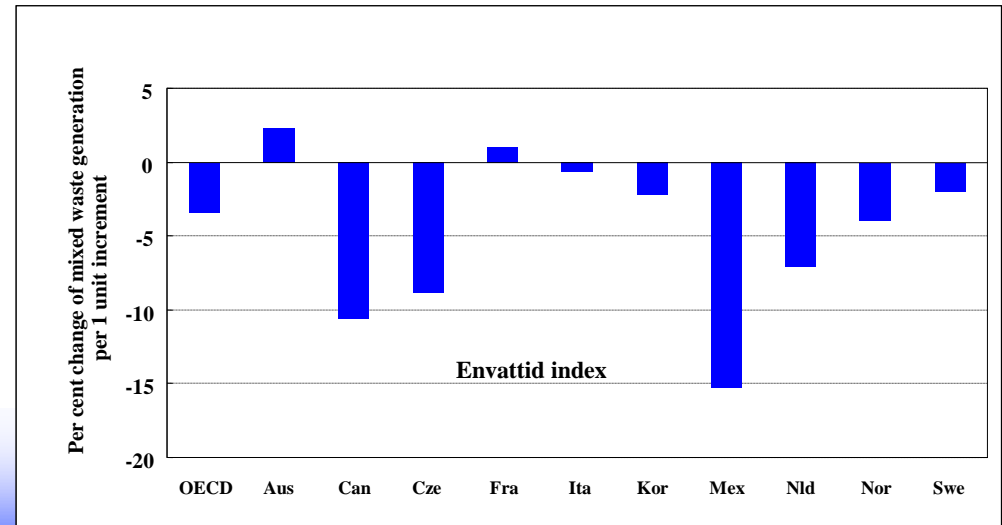
	Poisson				Order probit			
	Parameter	Coeff	p-value		Parameter	coeff	p-value	
Environmental Attitude	Envr_rank	0.0191	<.0001	***	Envr_rank	0.0405	<.0001	***
	Wgconcern	-0.0179	0.582		Wgconcern	-0.00007	0.9992	
	Envcnern_idx	0.0167	0.2399		Envcnern_idx	0.0128	0.6495	
	Env_affi	-0.0062	0.7542		Env_affi	0.0372	0.3467	
	Envattid_idx	-0.0351	0.0016	***	Envattid_idx	-0.0635	0.0045	***
	Envpurch_idx	-0.0831	<.0001	***	Envpurch_idx	-0.111	<.0001	***
Motive of Recycling	BENEFICIAL	-0.0581	0.1414		BENEFICIAL	-0.053	0.5175	
	MANDATED	0.017	0.2726		MANDATED	0.0968	0.0016	***
	SAVING	0.0191	0.1971		SAVING	0.0225	0.4458	
	CIVIC	0.0457	0.0785	*	CIVIC	0.0347	0.4851	
	RESPONSE	0.0192	0.222		RESPONSE	0.00981	0.754	

4. 4 Impact of Environmental Attitude on Waste Generation



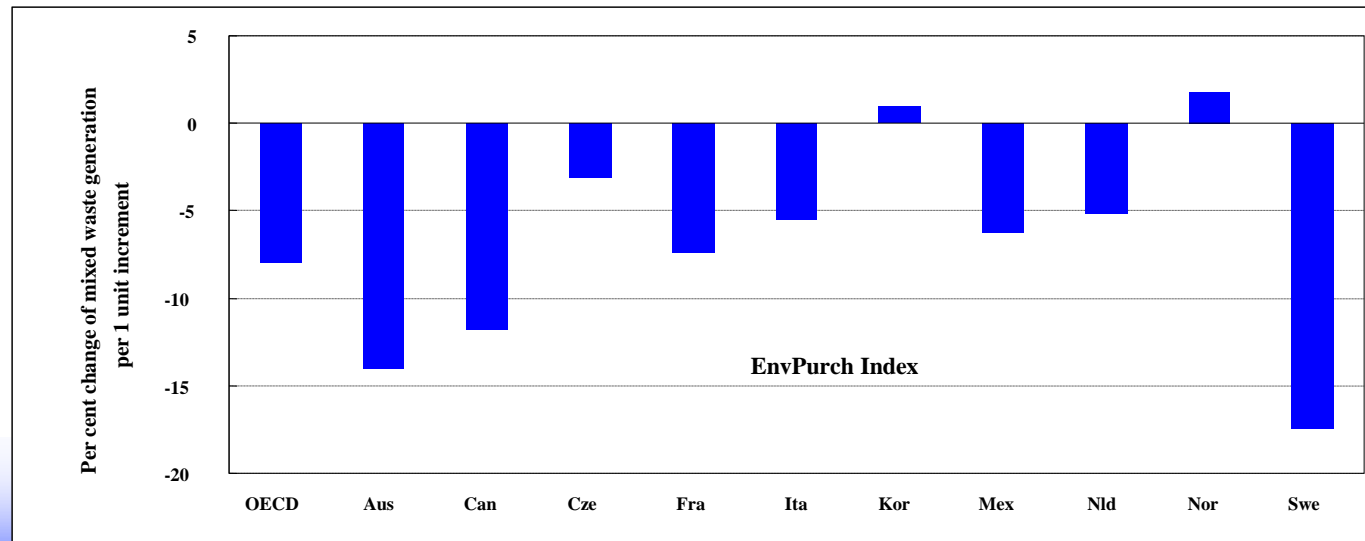
← • Environmental Rank

• Envattid Index



4. 4 Impact of Environmental Attitude on Waste Generation

- ENVRANK
 - A positive impact on waste generation
 - waste generation increases by 1.93% as the ranking of environmental problems increase 1 unit
- An index of purchasing environmental goods (ENVPURCH INDEX)
 - A very significant impact on waste generation at the 1% level

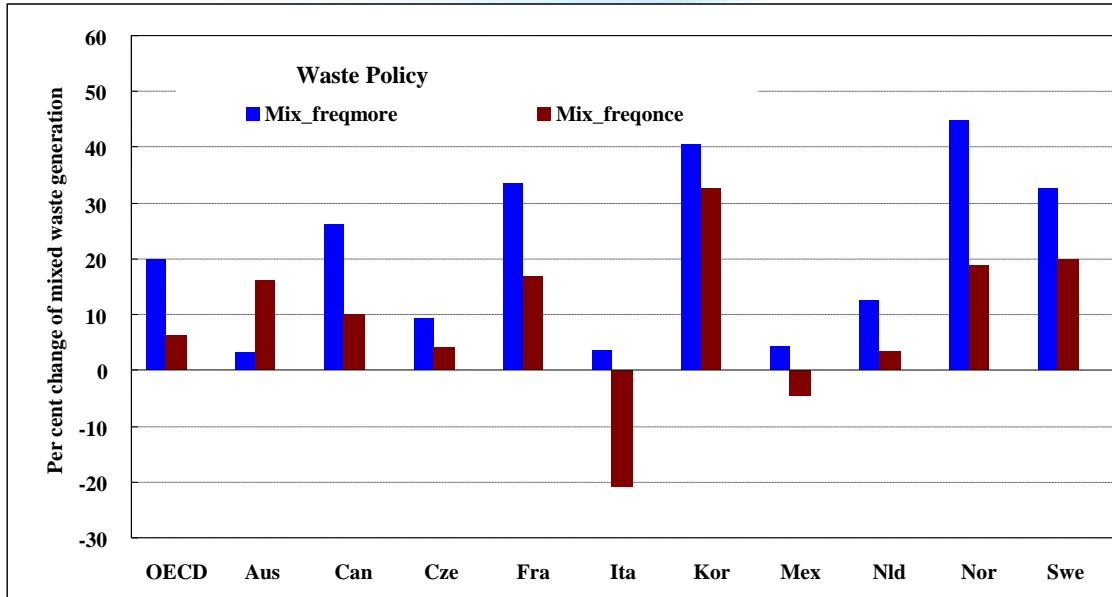


4.5 Impact of Policy on Waste Generation

- Poisson & Ordered Probit Estimation Result of Waste Generation

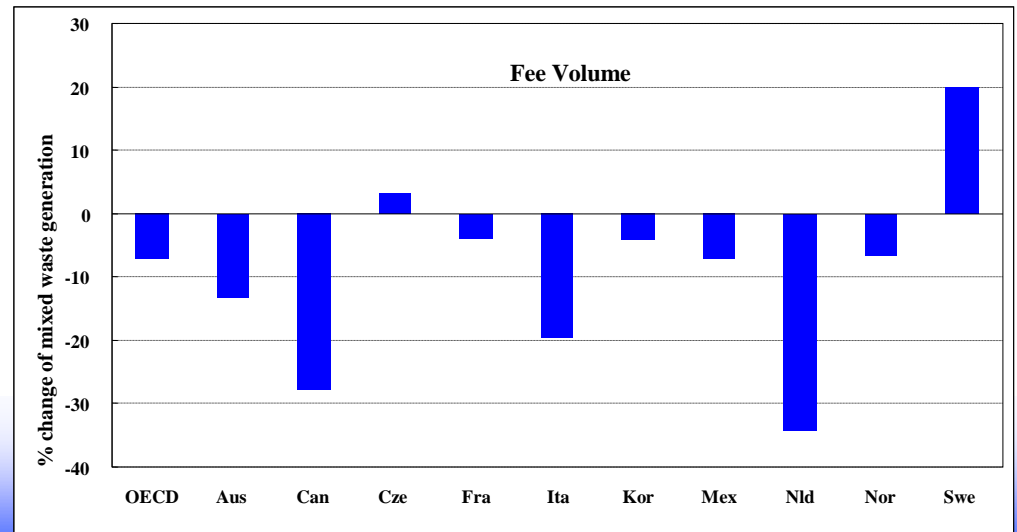
	Poisson				Order probit			
	Parameter	Coeff	p-value		Parameter	coeff	p-value	
Policy Variables	Fee_weight	0.027	0.526		Fee_weight	0.1334	0.1526	
	Fee_volume	-0.0738	0.0113	**	Fee_volume	-0.2175	<.0001	***
	Fee_frequency	0.0066	0.8403		Fee_frequency	0.0861	0.2178	
	Mix_freqmore	0.1821	<.0001	***	Mix_freqmore	0.3423	<.0001	***
	Mix_freqonce	0.0613	0.0041	***	Mix_freqonce	0.1365	0.0006	***
	Log Likelihood	2315.69			Log Likelihood	2412.18		
	X^2	10417.8						
	Number of Observations	7719			Number of Observations	7719		

4.5 Impact of Waste Policy on Waste Generation



← • Waste Policy

• Fee Volume →



4. 5 Impact of Waste Policy on Waste Generation

- Only 2 % of respondents
 - Subject to weight based fee in total data set of 10 OECD countries
 - The rate of weight based fee implemented in each country is 5%
 - Mexico and Korea, 4% in the Netherlands and Sweden, 2% in Australia, Canada, and Italy.
- 12 % of respondents
 - Subject to a volume based fee.
- Collection frequency
 - An important impact on mixed waste generation

4.6 Comparison with Literatures

- Comparison of OECD survey Results with Results of Literature

Variable names	Description	Sign	Sign in Literatures
MARRIED	Dummy, married or living as a couple	+ (***)	Fullerton and Kinnaman(+)
MALE	Dummy, male	- (**)	Linderhof <i>et al.</i> (female +, male-);
AGE 18-24 AGE 25-34 AGE 35-44 AGE 45-54	Dummy for age group; reference age group: AGE55 – older between 18 and 24 years of age; age between 25 and 34 years; between 35 and 44 years; between 45 and 54 years	+ (***) + - +	Linderhof <i>et al.</i> (age -); Podolsky and Spiegel (age, -) Stern and Bartelings(age, -) Nestor and Podolsky(over 65, -);
NOHS HS; SOMEPS; BA	Dummy, education level. no high school; high school, post-secondary; Bachelor's Degree	+ + + -	Kinnaman and Fullerton (edu, -); Van Houtven and Morris (high school, -) Judge and Becker (college edu. +)
EMPLET EMPLPT RETIRED; HWIFE STUDENT	Dummy, status of employment	+ (**) + + (***) + + (**)	Nestor and Podolsky (full time, +); Van Houtven and Morris (full time, -) Stern and Bartelings(people staying at home, -)
ADULTS	Number of adults	+ (***)	Hong <i>et al.</i> (+); Jenkins(+);Richardson and Havlicek(+); Van Houtven and Morris (+); Hong(size,+); Jenkins(size-); Judge and Becker(size+); Linderhof <i>et al.</i> (size +); Nestor and Podolsky(size, +); Podolsky and Spiegel (size, -); Richardson and Havlicek(+);
CHILDREN 5	Children under age 5 years	+ (***)	Fullerton and Kinnaman(+); Linderhof <i>et al.</i> (40)

4.6 Comparison with literatures

- Comparison of OECD survey Results with Results of Literature (Cont.)**

Variable names	Description	Sign	Sign in Literatures
CHILDREN 5 to18	Children from 5 to 18 years old	+(***)	
INCOME_CONT	Income level (Euro)	+(*)	Fullerton and Kinnaman(-); Hong(+);Hong et al.(+); Jenkins(+); Kinnaman and Fullerton (+); Nestor and Podolsky(+); Podolsky and Spiegel (+); Richardson and Havlicek(+); Van Houtven and Morris (+)
OWNERSHIP	House ownership	-	Hong et al.(home rental, +); Nestor and Podolsky (-);
HOUSE	Types of house-detached house/apartment	-	
N_ROOMS	Number of rooms	+(***)	
GARDEN	Dummy, garden	+	
URBAN	Dummy, living in a urban or suburban	+(***)	Van Houtven and Morris (-)
ENVRANK	Attitude on the importance of env. Issues compare to other issues, 1 to 6	+(***)	
WGCONCERN	Concerns on waste generation, (= 1 if fairly concerned, if concerned, if very concerned(=4) and =0 if not (=1)	-	Van Houtven and Morris (importance of waste reduction, -)
ENVCNCRN_INDX	Environmental concern index	+	
ENV_AFFI	Dummy, Member of environmental organization or contribution	-	
ENVATTID_INDX (attitude to environment)		-(***)	41

4.6 Comparison with Literatures

- Comparison of OECD survey Results with Results of Literature (Cont.)**

Variable names	Description	Sign	Sign in Literatures
ENVPURCH IND		-(***)	
BENEFICIAL	Reason to participate in recycling-	-	
MANDATED	Mandated by government	+	
SAVING		+	
CIVIC	Civil duty-	+(*)	
RESPONSE	Responsibility	+	
FEE_WEIGHT FEE_VOLUME FEE_FREQUE NCY).	Dummy, implementation status of waste unit pricing system (WEIGHT, volume, frequency based)	+ -(**) +	Hocket, Lober and Pilgrim (-);
MIX_FREQMO RE MIX_FREQON CE	Dummy, collection frequency (more than once a week pick up; once a week pick up).	+(***) +(***)	

5. Policy Implication

- Summary of variables that have significant impact on waste generation
 - Personal attributes – Married, Gender, Age18-24(young adult)
 - Household attributes – adults, children under 5, children 5-18, income, number of rooms, urban (types of residential area)
 - Environmental attitude – env. Rank, envattid index, envpurch index
 - Recycling motives – beneficial
 - Policy – volume based fee, collection frequency

5. Policy Implication

- Targeted waste policies considering household attributes can bring about a reduction in waste generated.
 - For example, waste policy can be formulated differently depending upon housing types, income group, characteristics of residential area (e.g. village where the elderly are concentrated or a village where the young are concentrated), urban or rural, and age groups.
 - For the purpose of administration/implementation convenience, characteristics of housing area can be reflected in waste policy if the area can be differentiated according to urban or rural, area where young or old group households live,
 - If not, it may not be able to target in such a manner.

5. Policy Implication

- For the group who purchase environmental goods, provision of incentives to reduce waste generation may be possible since this group generates less waste
- Expansion of Unit charge system- especially volume based waste fee system is recommended considering living pattern, household characteristics, and types of residential area.
- Collection service such as frequency needs not to be too convenient. Need to be adjusted with recycling frequency

5. Policy Implication

- Taking into account Country specific condition is very important.
 - Policy impact seems differ depending upon country's economic and social conditions according to the empirical result of each country's data.
 - Thus these differences need to be taken into account when we introduce waste policy in each country.

• Thank you for Listening!

• Any Comment!

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