Putting a Price on Trash: *Does Charging for Food Waste Reduce Total Waste?* The Case of Korea

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Does Charging for Food Waste Reduce Total Waste?

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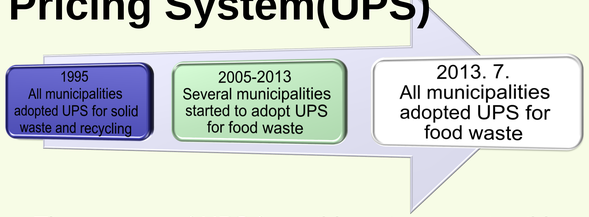
Background: Unit-based Pricing System(UPS)



- The success of UPS for solid waste: annual solid waste per capita fell from 485.5kg to 376.0 kg between 1994 and 2004
- After 2000, increasing food waste had become a big burden to municipalities
- After adopting UPS for food waste, municipal residents should purchase two bags for total waste

Objectives

- Estimating the effect of adopting UPS for food waste on the volume of solid waste
- Using a natural experiment based on causal inference
- Identifying whether the adopting UPS for food waste, increasing marginal price of food waste, has a substitution effect on the use of bags for solid waste
- Finding the own price elasticities of bags for solid waste and for food waste
- Assessmenting the effect of environmental activism

Two-period, Difference-in-difference model

- The two-period regression model for municipality i in year t, can be written as:

$$\ln(y_{it}) = \alpha_i + \lambda t_{it} + \delta d_{it} + \gamma t d_{it} + \eta \ln(\mathrm{P}_{it}) + X'_{it}\beta + \varepsilon_{it} \quad (1)$$

$$\ln(y_{it}) = \alpha_i + \lambda t_{it} + \delta d_{it} + \gamma t d_{it} + \theta \boldsymbol{td_{it}}\, \boldsymbol{ln(P_{it})} + \eta \ln(\mathrm{P}_{it}) + X'_{it}\beta + \varepsilon_{it} \quad (2)$$

where $\ln(y_{it})$is the log of the quantity of residential solid waste per capita, $\alpha_i$is the municipal-level fixed effect, $\ln(\mathrm{P}_{it})$ represents the log of the average price of a bag for solid waste per1L, X'_{it}represents a vector of control variables including the number of illegal dumping reports, the log of the quantity of residential recycling, and the log of per capita income, and ε_{it} is the standard idiosyncratic disturbance term

Multiple-period, Fixed effect model

- The multiple-period regression model for municipality i in year t, can be written as:

$$\ln(y_{it}) = c + \eta \boldsymbol{D_{it}} + \tau \ln(P_{it}) + X'_{it}\pi + \delta_i + \lambda_t + \varepsilon_{it} \quad (3)$$

$$\ln(y_{it}) = c + \gamma\, \boldsymbol{ln(PF_{it})} + \tau \ln(P_{it}) + X'_{it}\pi + \delta_i + \lambda_t + \varepsilon_{it} \quad (4)$$

where $\mathrm{D}_{it}$is a dummy variable representing the adoption of UPS on food waste. $\ln(\mathrm{P}_{it})$ is the average price of bag for solid waste per 1L,and PF_{it} is the relative price which is the ratio of the price of bag for food waste to the price of bags for solid waste

Results

Dependent variable: ln (the volume of bags sold for solid waste per capita)	Model (1)			Model (2)		
	Data 1	Data 2	Data 3	Data 1	Data 2	Data 3
Diff-in-diff	-0.4012*** (0.126)	-0.2684*** (0.090)	-0.1717** (0.081)	1.1584** (0.469)	0.6287 (0.432)	0.3278 (0.321)
Diff-in-diff* ln (average price of bags for solid waste per 1L)				-0.4867*** (0.139)	-0.2658** (0.119)	-0.1483* (0.089)
Treatment group	0.9835*** (0.320)	0.1724 (0.256)	-0.2631 (0.204)	0.9319*** (0.323)	0.1349 (0.249)	-0.2473 (0.199)
Post-treatment	0.0844 (0.134)	0.0544 (0.095)	0.0331 (0.100)	0.0533 (0.138)	0.0508 (0.094)	0.0316 (0.100)
ln (average price of bags for solid waste per 1L)	-0.8183*** (0.262)	-0.2946 (0.212)	-0.3185 (0.240)	-0.5861** (0.275)	-0.1870 (0.228)	-0.2830 (0.245)
ln (per capita income)	0.3427* (0.201)	0.4430 (0.293)	0.2249 (0.322)	0.3740* (0.207)	0.3898 (0.270)	0.1997 (0.320)
Per capita number of illegal dumping reports			0.2967 (0.972)			0.2289 (0.864)
ln (per capita quantity of recycled waste)			0.0397 (0.034)			0.0310 (0.035)
Constant	0.3039 (0.937)	-1.6569 (1.049)	-0.5786 (1.133)	-0.4084 (0.925)	-1.8423* (1.031)	-0.6478 (1.124)
Observations	180	142	136	180	142	136
R-squared	0.84	0.90	0.93	0.87	0.91	0.93
F-Statistics	4.88	8.55	11.36	5.92	8.95	11.37
Post period	2010	2010	2010	2010	2010	2010
Pre period	2003	2005	2006	2003	2005	2006

Dependent variable	ln (the volume of bags sold for solid waste per capita)		ln (the volume of bags sold for food waste per capita)
	Model (3)	Model (4)	Model (5)
ln (the average price of bags for solid waste per 1L)	-0.2636*** (0.083)	-0.2607*** (0.081)	0.5589 (0.631)
ln (the average price of bags for food waste per 1L)		-0.0028 (0.007)	-0.3172** (0.157)
UPS on food waste	-0.0403** (0.020)		
ln (per capita income)	0.2147** (0.098)	0.2159** (0.097)	-0.1074 (0.400)
The number of illegal dumping reports per capita	-0.0073 (0.005)	-0.0071 (0.005)	0.0393 (0.036)
ln (the quantity of recycled waste per capita)	0.0131* (0.007)	0.0130* (0.007)	-0.0654 (0.051)
Constant	-1.0422*** (0.392)	-1.0617*** (0.383)	-9.1249*** (2.125)
Observations	824	824	412
R-squared	0.91	0.91	0.93
F-Statistics	36.42	36.11	41.20

Standard errors are clustered at the municipal level and presented in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Municipal-level fixed effects and year effect are included. Prob>F in all models are 0.0000. Number of observation through model (1)-(4) decreased because a lot of region GDP data are missing and data on the number of illegal dumping reports per capita and the quantity of recycled waste per capita are only available on 2006-2010.

Data

- Data on the number of bags for solid waste and for food waste sold per municipal for 2003-2010 and for 232 municipalities are available from STATISTICS KOREA
- As socio-economic control variables, data on population and regional GDP at the municipal level are also from STATISTICS KOREA.
- Department of Environment also provides data on the number of total illegal dumping incidents reported by residents and public official and the quantity of recycled waste.

Conclusions

- This research initially examines the impact of a unit-based pricing system (UPS) for food waste on both solid and food waste in Korea using a difference-in-differences method.
- Adopting UPS for food waste has a significant negative effect on the volume of solid waste.
- No substitution effect exists between bags for solid waste and bags for food waste
- The own-price elasticities for solid waste bags and for food waste bags are statistically significant.
- Except for the environmental activism effect including the adoption of UPS and the participation of recycling, the price effect still remains

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