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Waste separation at home: Are Japanese municipal curbside recycling policies efficient?

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ABSTRACT

Recent studies have predicted that the costs and benefits of curbside recycling programs will vary considerably across municipalities. In this paper, we examine how the characteristics of municipalities are reflected in curbside recycling policies. Our analysis of Japanese municipal data reveals that municipalities implement recycling programs that fit the demographic profiles of their residents. Municipalities with a considerable number of single-recycler households tend to implement simple waste separation programs. The labor market positions of spouses have different impacts on recycling policies. We further find that the municipalities implementing comprehensive recycling programs collect plastic bottles and containers more frequently than do other municipalities. This implies that the municipalities need to take measures to effectively execute comprehensive recycling programs after implementing them.

1. Introduction

In recent years, curbside recycling programs have been implemented by many municipalities. Most of the programs require residents to sort their recyclables at home.[1] Households have to spend time separating and cleaning recyclables to participate in the programs; thus, the time-cost of recycling participation varies across households.

Morris and Holthausen (1994) developed a household production model of waste decision-making and characterized household recycling behavior. Since then, empirical studies have been conducted in several countries. These empirical studies all demonstrate that the socioeconomic characteristics of households influence their participation in recycling programs.

Jakus et al. (1996, 1997) examined household decisions regarding participation in a voluntary recycling program in a rural area of Williamson County, Tennessee, USA, and showed that old people were more likely to recycle than young people; that recyclers had, on average, higher incomes than nonrecyclers; and that both time-cost and storage space influenced participation rates. Sterner and Bartelings (1999) examined the determinants of waste disposal, recycling, and composting in south-west Sweden and found that the effect of sociodemographic variables on recycling participation changed with recyclables. For example, in their study, the recycling rate of newspaper increased as the number of persons in the household increased, but that of textiles decreased. Ekere et al. (2009) found that, in the Lake Victoria crescent of Uganda, gender, peer influence, location of household and membership in environmental organizations explained household waste separation behavior.

Previously, curbside recycling was conducted by local residents on a voluntary basis. However, in recent years, numerous municipalities have introduced mandatory recycling programs. For example, in the United States, 22 out of 50 states now require all municipalities to establish and mandate participation in curbside recycling programs (Kinnaman, 2006).

Since the characteristics of households determine their recycling behaviors, and sociodemographic conditions vary across municipalities, we expect different municipalities to adopt different recycling programs. Subsequently, we expect the complexity of recycling programs to vary extensively across municipalities.

On observing the variation in municipal curbside recycling programs, a natural question arises: are municipal recycling policies efficient? Despite the growing trend of mandatory recycling programs, this question has not been examined in previous papers. The purpose of this paper is to fill this gap.

In this paper, we analyze Japanese municipal data. Over 92% of the municipalities in Japan have recycling programs (Medina, 2008). Because each municipality is permitted to select a recycling program to suit its local conditions, a large variation in the degree of waste separation is observed across municipalities. Since 1998, the Ministry of the Environment of Japan has conducted an annual survey of the recycling conditions of all Japanese municipalities that

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[1] Recycling programs introduced in many countries typically aim to induce households to separate different type of waste and, by implication, to reduce its amount in the overall mixed waste stream (Aalbers and Vollebergh, 2008).

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Table 1
Empirical summary from household-level studies.

Sociodemographic variables	Yes	Not necessarily
Gender: Are women more involved in recycling activities?	Schultz et al. (1995), Saphores et al. (2006), Ekere et al. (2009), and Sidique et al. (2010)	Vining and Ebreo (1990), Gamba and Oskamp (1994), and Werner and Makela (1998)
Income: Do high-income people engage in recycling more actively?	Vining and Ebreo (1990), Oskamp et al. (1991), Gamba and Oskamp (1994), Ekere et al. (2009), and Sidique et al. (2010)	Derksen and Gartrell (1993) and Scott (1999)
Education: Do well-educated people engage in recycling more actively?	Derksen and Gartrell (1993), Jakus et al. (1996), Owens et al. (2000), and Saphores et al. (2006)	Vining and Ebreo (1990), Oskamp et al. (1991), Gamba and Oskamp (1994), Werner and Makela (1998), and Meneses and Palacio (2005)
Age: Are elderly people cooperative with respect to waste reduction effort?	Vining and Ebreo (1990), Derksen and Gartrell (1993), Gamba and Oskamp (1994), Jakus et al. (1996), Margai (1997), Scott (1999), Meneses and Palacio (2005), and Saphores et al. (2006)	Werner and Makela (1998)

has provided us with an ideal opportunity to evaluate the efficiency of local recycling programs.

Recycling is a time-consuming and unpleasant practice for some households. Under mandatory recycling programs, all residents are responsible for source separation of recyclable items. However, some residents do not perform their sorting duties and consequently dispose of mixed wastes. Mixed wastes are problematic because both incineration plants and landfill sites are designed to accommodate certain waste categories and it is therefore difficult to directly incinerate or dump mixed wastes. When residents dispose of mixed wastes, municipalities have to extract recyclables from those wastes. The extraction is difficult to mechanize and is often done by hand under poor working conditions.

However, for other households recycling is a desirable practice. Previous empirical studies have indicated that many households value the opportunity to recycle (Aadland and Caplan, 2003; Berglund, 2006; Nakatani et al., 2008; Sterner and Bartelings, 1999). Kinnaman (2000) and Bohm et al. (2009) found that the municipalities' costs of collecting, processing, and transporting recyclable materials exceeded the budgetary benefits of reduced disposal fees and revenues from the sale of recyclables by roughly US$3 per household per month. These results suggest that municipalities consider the warm-glow utility of their residents when designing recycling programs.

In the last two decades, Japanese municipalities have increased waste separation categories under the slogan "separation is resource and mixing is waste," and wastes are now separated into more than 10 categories in many municipalities. Residents have to wash and store recyclables at home before taking them to their designated collection sites on their specified collection days. Municipalities have been criticized for tending to adopt complex recycling programs without evaluating operational costs (Sugimoto and Hattori, 2009). In this study, we use information from previous household-level analyses of the effects of demographic characteristics on recycling participation to examine whether or not municipalities have been implementing programs that fit the demographic profiles of their residents.

In Section 2, we survey the relevant literature and choose sociodemographic variables for our empirical analysis. Section 3 presents the sources of data, Section 4 specifies our empirical models, and Section 5 reports empirical findings. We find that Japanese municipal recycling policies are efficient in the sense that the characteristics of the municipalities determine the complexity of their recycling programs. We also find that after introducing comprehensive recycling programs municipalities take measures to reduce households' recycling costs. Section 6 discusses our findings and states policy implications.

2. Literature survey

In this section, we review the literature that studies household participation in voluntary recycling programs. We then derive predictions about the effects of sociodemographic conditions on waste separation programs.

2.1. Sociodemographic variables

A number of previous studies based on household-level data have examined the relationship between sociodemographic variables and recycling intensity, with the most commonly examined sociodemographic (family situation) variables being gender, age, education, and income (Saphores et al., 2006).

The research methods of these previous studies can be divided into three categories. One category of studies compares the sociodemographic characteristics of recyclers and nonrecyclers: Table 1 summarizes the findings from these studies. Schultz et al. (1995), Saphores et al. (2006), Ekere et al. (2009), and Sidique et al. (2010) found that women were likely to be more involved in recycling activities than men. However, Vining and Ebreo (1990), Gamba and Oskamp (1994), and Werner and Makela (1998) found no statistically significant relationship between recycling behavior and gender. No literature shows men to be more cooperative than women with respect to recycling.

Vining and Ebreo (1990), Oskamp et al. (1991), Gamba and Oskamp (1994), Ekere et al. (2009), and Sidique et al. (2010) all found a positive relationship between income level and recycling involvement. In contrast, Derksen and Gartrell (1993) and Scott (1999) detected no relationship. No literature demonstrates that low-income people are more active recyclers than people with high incomes.

Derksen and Gartrell (1993), Jakus et al. (1996), Owens et al. (2000), and Saphores et al. (2006) found that well-educated people were more likely than less-educated people to recycle waste. However, Vining and Ebreo (1990), Oskamp et al. (1991), Gamba and Oskamp (1994), Werner and Makela (1998), and Meneses and Palacio (2005) found that education did not contribute to recycling involvement. No literature shows that less-educated people are more likely to recycle than well-educated people.

Vining and Ebreo (1990), Derksen and Gartrell (1993), Gamba and Oskamp (1994), Jakus et al. (1996), Margai (1997), Scott (1999), Meneses and Palacio (2005), and Saphores et al. (2006) presented that older people were more likely than younger people to recycle waste. In contrast, Werner and Makela (1998) found no relationship between age and recycling involvement.

The second category of studies uses the recycling rate as a measure of recycling intensity. Sterner and Bartelings (1999) used data from Swedish municipalities to explain the amount of reported recycling of seven categories of recyclables: glass, paper, refundables, batteries, hazardous wastes, household machines, and textiles. Subsequently, they indicated the manner in which sociodemographic variables influenced the recycling rates of these seven recyclables. Moreover, they established that the extent of the impact of sociodemographic characteristics varied across