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Analyzing the success of the volume-based waste fee system in South Korea

Seejeen Park [a], T.J. Lah [b,*]

[a] Department of Public Administration, Kwangwoon University, Republic of Korea
[b] Department of Public Administration, Yonsei University, Republic of Korea

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ABSTRACT

For more than a decade, South Korea has been ranked first among the OECD (Organization for Economic Cooperation and Development) members in their municipal solid waste (MSW) recycling rate. One of the major contributing factors for its outstanding MSW recycling performance is the volume-based waste fee (VWF) system implemented in 1995. Despite the perceived success of VWF, there has been few research conducted that has sought to demonstrate the success of the policy in an empirical manner. Research conducted currently on VWF in South Korea tends to have limitations in empirical approaches and identifying the intervention effect of VWF on recycling performance. This study attempts to empirically test whether the adoption of VWF positively affected recycling performance in Korea over time. The findings suggest that although there was a dramatic increase of the recycling rate with the introduction of VWF in 1995, Korea's MSW recycling performance settled back again and showed the constant pace after the intervention. No significant differences in recycling rate were found between before and after 1995 period. In conclusion, implications and suggestions for both research and practice are proposed.

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1. Introduction

For more than a decade, South Korea has been ranked first among the OECD (Organization for Economic Cooperation and Development) members in their municipal solid waste (MSW) recycling rate. In the most recent data released, in 2012, the MSW recycling rate of South Korea was 59.1% while the average estimated recycling rate of the other members was 24% (MOE, 2013a, 2014a; OECD, 2014). One of the major contributing factors for its outstanding MSW recycling performance is the volume-based waste fee (VWF) system implemented in 1995 (MOE, 2003, 2011). Focusing on the household MSW recycling in South Korea, this study investigates the effect of the VWF program. First, this study briefly discusses past research in household MSW recycling to argue that policy adoption perspective regarding waste management policies needs attention. Second, volume-based waste fee system (VWF) in South Korea is summarized and related research is reviewed to assess whether the effect of VWF on recycling performance in Korea has been sufficiently investigated. Recycling performance, in this study, is represented by recycling rates. Third, for the empirical analysis, the effect of the adoption of VWF on recycling performance is assessed by using segmented linear regression. Lastly, this study concludes by discussing the effect of VWF on recycling performance and offering implications for future research.

1.1. Past research in household MSW recycling

This study focuses on MSW recycling, meaning separate collection of potential recyclables from MSW. In recent household MSW recycling literature, there are two major streams of research. First stream is the studies related to household MSW recycling behavior, which focused on topics such as unit (quantity)-based pricing (Dijkgraaf and Gradus, 2004; Gellynck et al., 2011; Miranda and Aldy, 1998), household's willingness-to-pay (WTP) which measures how much households would pay to use curbside service (Hazra et al., 2013; Saphores et al., 2012), the effects of curbside recycling (Best and Kneip, 2011; Domina and Koch, 2002) the socio-psychological determinants of rural household recycling behavior (Tang et al., 2011), and the influence of demographic factors on recycling behavior (see Park and Berry, 2013; Saphores and Nixon, 2014 for further reference). In these studies, the unit of analysis was usually individuals because the main purpose was to study how various factors influence household recycling behavior and to suggest ways to increase recycling by affecting individual-level behavior.

* Corresponding author.
E-mail address: tjlah@yonsei.ac.kr (T.J. Lah).

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Next stream, related to the interest of this study, is composed of the studies focused on recycling policy rather than recycling behavior. Examples of topics include, varying effects of different types of MSW recycling programs (e.g., curbside, pay-as-you-throw, recycled product market) on recycling performance (Park and Berry, 2013), social cost for setting ineffectively high recycling policy goals (Kinnaman et al., 2014), recycling system policy reforms (Mo et al., 2009), sustainable MSW policy development (Moh and Manaf, 2014), MSW policy and administration in developing countries (Troschinetz and Mihelcic, 2009), and source-separated MSW policy implementation issues (Tai et al., 2011). In these studies, the main interest was the effectiveness of policies and the process of implementing it; thus the unit of analysis was usually policies rather than individual households.

Following the second stream of research in household MSW recycling, this paper departs from an individual-level analysis and investigates the MSW recycling rate (performance) from the pre- and post-policy adoption perspective. South Korea as a country is the basic unit of analysis because all provinces and local governments were legally mandated to implement VWF starting January 1, 1995.

1.2. Volume-based waste fee system

Many Asian countries (e.g., Korea, Malaysia, Singapore) are now in the process of striving to simultaneously fulfill both economic and environmental goals and South Korea, in the area of waste management practices, is considered one of the countries implementing sustainable waste management practices (Agamuthu et al., 2009). In South Korea, public concern for environmental problems created by MSW has increased since the early 1990s, and this phenomena increased pressure on the Korean government to develop waste management policies such as a volume-based waste fee system (VWF) to reduce MSW waste and increase recycling (Seo et al., 2004). Consequently, the Ministry of Environment (MOE) conducted a pilot test of VWF in 1994 in a number of municipalities, and after the pilot program's success, VWF was implemented nationwide as of January 1, 1995 (MOE, 2011) (see Kim, 2002, for a comprehensive review).

The target groups for VWF are mainly households and small businesses (e.g., markets, shopping arcades) that produce less than 300 kg of waste per day. According to MOE (2011, p.16), the basic principles of VWF are as follows: (1) households (or small businesses) are required to purchase standardized plastic waste bags produced and sold by local governments, (2) wastes are to be put into the plastic bag and left for collection, (3) recyclables such as paper, plastic, and cans are collected from containers or bins placed near residences at no charge. VWF is still in effect nationwide in South Korea. The typical price of the waste bags in Seoul, which is the largest city in Korea, ranges from 0.05 U.S. dollars (52 KRW) for a 2 l bag to 1.8 U.S. dollars (1840 KRW) for a 100 l bag (SMG, 2013).

From the economic perspective, under the VWF system, it can be expected that because households are required to purchase waste bags to dispose of MSW, they will be motivated to recycle as much as possible rather than disposing of recyclables as waste to reduce the cost of purchasing waste bags. In fact, after the implementation of VWF, MOE (2011, p.19) reported that households and small businesses formed the consensus that "throwing out waste was like throwing out money..." and began to use products with less packaging and refill functions to reduce waste output.

VWF was regarded as highly successful in increasing recycling performance (Lee and Paik, 2011; MOE, 2011) and several past studies have sought to demonstrate the success of the policy in an empirical manner.

In 2011, MOE published a report that summarized the successes of VWF but only compared MSW generation and recycling mean values in the years 1994, 1998, and 2004 to claim that decrease in MSW generation and increased recycling are the results VWF adoption (MOE, 2011). Prior to the MOE report, several studies assessing VWF appeared in the Korean MSW literature. First, a study by Hong and Seonghoon (1999) conducted survey to more than 3000 Korean households and found that weight-based pricing system is more effective than VWF in inducing recycling but VWF was still a success because of reduced waste and increased recycling. Next, Oh, 2006 using Korean MSW data from 1990 to 2004 and descriptive statistics, argued that the positive effect of VWF on reducing waste is limited because such trend has been present since 1992 and the rate of reduction has decreased after the adoption of VWF. Following Oh's study (2006), Jeong and his colleagues (2007), using an interrupted time series analysis, compared the MSW generation and recycling amount of 15 provinces and metropolitan areas before and after the adoption of VWF. The panel data composed of MSW data of 15 regions was divided into two periods to form a control group (1992–1994) and a treatment group (1995–2004). The results revealed that the treatment group showed decreased MSW generation and increased recycling amount, supporting the positive effect of VWF. Although the presented studies assessed VWF in various aspects, their claim has a number of limitations that need to be addressed.

First, as shown in Fig. 1, where it shows the trend of Korea's MSW generation and recycling amounts from CY (calendar year) 1986 to 2012, the annual recycling rate in Korea had been exhibiting an upward trend before 1995; thus it is necessary to identify whether improved recycling performance is a result of an upward trend or of VWF. Scholars such as Oh (2006) and Jeong et al. (2007) have conducted either trend or time series analysis but missed to account for the policy intervention effect. Second, the annual MSW generation amount steeply declined from 1991 to 1995 and has been maintaining a steady trend since then (Fig. 2). The steep decline is the result of decreased generation of MSW materials such as food, paper, wood, coal briquette, and metal (MOE, 1996, p.5). The main contributors were food and coal briquette waste that decreased as a result of income increase which led to improved Korean household dietary life style and shift of popular heating system from coal briquette to gas and oil (Jeong et al., 2007). Accordingly, the effect of generated MSW on recycling performance has to be accounted for and this study does this by measuring performance by recycling rates rather than amount. VWF is a policy designed to minimize or prevent waste generation from household, and may not be directly related to improving recycling behavior. However, under VWF system, households are incentivized to recycle more to save plastic bag cost so that the recycled amount is inevitably affected. Thus, rather than following past research (e.g., Oh, 2006; Park, 2009) that assessed VWF performance by changes in generated MSW amount, this study uses recycling rate which measures the percentages of the recycled materials relative to the total MSW generation to capture the genuine pattern change as a result of VWF. Lastly, past research was limited in accounting for the effects of VWF over time. The MOE report (2011) selected only a few time periods (1994, 1995, 1998, 2004, 2007) for observation. A study by (Hong and Seonghoon, 1999) used cross-sectional data composed of responses from approximately 3000 Korean households. Oh (2006) used time-series data but only conducted descriptive analysis. Jeong et al. (2007) focused on comparing the control group (pre-VWF: 1992–1994) and treatment group (post-VWF: 1995–2004), but did not show the VWF performance in the first year (1995) of its implementation.

This study, resolving the limitations of past research discussed above, attempts to empirically test whether the adoption of VWF

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