

It's Not the Seattle Stomp Anymore!

Cities in King County (Washington), including Seattle, have been using aggressive economic incentives and programs such as curbside recycling to stimulate waste diversion for most of this decade, long enough for these methods to achieve their full impacts on behavior. Virtually all households and businesses in King County have been, and continue to be, exposed to consistent, repeated public media messages promoting waste reduction and recycling. At the same time, diversion program characteristics and incentives differ significantly among cities, as do geographic, demographic and socio-economic factors.

King County cities, thus, provide a textbook case for using statistical methods to determine what works best to reduce waste disposal and increase diversion. The cities are diverse and use diverse waste management methods. Furthermore, given publicity throughout King County for recycling, there is less likelihood that quantitative measurement of success factors could be biased by differences among cities in important unmeasured or unmeasurable factors such as the extent of promotion, education and moral suasion regarding recycling.

Economic Incentives Increase Diversion by Over 25 Percentage Points

Conclusions reported in this article are based on statistical analysis of 1998 single-family residential¹ solid waste collection quantities and user fees from sixteen King County, WA cities.² Information on program characteristics, such as collection frequency and material preparation requirements, as well as data on median household income, property values, and lot size, were also taken into account in this study.

Multivariate regression analysis was used to hold constant the influence of one set of measurable factors, e.g., income and garbage fee levels, while examining the in-

fluence of another factor, e.g., garbage rate structure. This technique revealed a number of significant success factors. Most important are two economic incentives that reduce residential garbage collection quantities and, simultaneously, increase diversion levels:

- ◆ Charges for curbside recycling and/or yard waste embedded in garbage collection fees – all garbage collection customers pay for the diversion program in their garbage collection fees; participation in curbside recycling and/or yard debris collection entails no additional charge.
- ◆ Unit-based garbage fees – the garbage collection customer pays at least as much for the second 32-gallon can (the “incremental” can charge) as is paid for collection of the first can.³

Embedding charges for curbside collection of either recycling or yard debris in garbage fees increases diversion by at least 11 percentage points. A further benefit of what might be called financially mandatory recycling is that the increased participation, compared with subscription-fee recycling, typically results in lower cost per participating household. This is due to collection efficiencies obtained when driving the recycling truck shorter distances between collection stops, thus increasing the amount of material loaded into the truck during a workday.

Using unit-based garbage fees instead of cost-of-service rates increases diversion by at least 4 percentage points. This is due to the strong economic incentive for diversion provided when additional cans of garbage cost as much as the first can.

Other statistically significant results from the regression analysis are:

- ◆ A city's median household income has similar effects on both garbage and recycling. For example, a \$10,000 increase in median household income yields an

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increase of 143 pounds in garbage collection quantity and 148 pounds in curbside recycling, other factors held constant. This increases the average diversion rate for the sixteen cities by almost half a percentage point.

- ◆ Both the amount a city charges on average for garbage collection, as well as incremental charges for additional cans of garbage, affect disposal and diversion. Interestingly, a city's incremental charge for a second can has a 15% larger impact on disposal than its average garbage fee. Incremental can charges appear to have been neglected in previous studies on variable can rates. This is an especially serious oversight for studies claiming to show that garbage fees have little or no impact on disposal and diversion levels.
- ◆ In cities that charge subscription fees for curbside recycling or yard debris collection, the higher the subscription fee in relation to the incremental garbage can charge, the lower the amount of waste diverted. For example, in the eight cities that charge a subscription fee for yard debris collection, a \$1 increase in that fee decreases diversion by at least one percentage point.
- ◆ Single-family lot sizes have a significant impact on yard debris collection. Each 5,000 additional square feet adds over 170 pounds to annual collections per household, holding constant other influences such as garbage fees and subscription charges for yard debris collection.

Solid Waste Collection Practices in King County

Solid waste management diversity in King County is revealed by summary data on collection quantities and diversion levels, garbage fees and garbage rate structures, and income levels and single-family lot sizes for the sixteen surveyed cities.

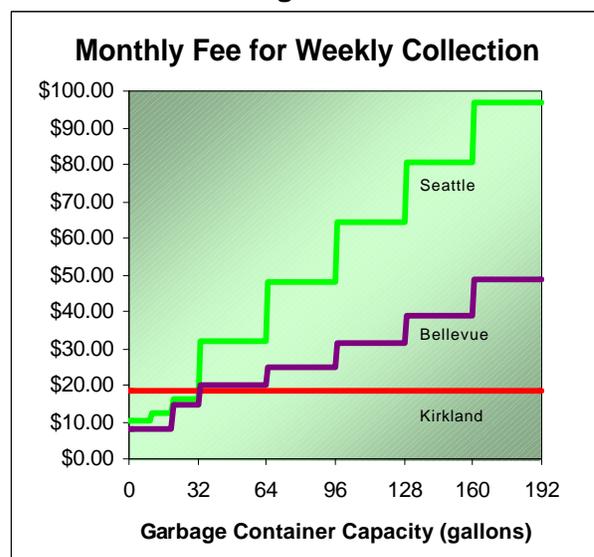
Garbage Collection Fee Structures

Garbage collection service subscribers in all sixteen cities pay a user fee for trash pickup. Typically, a subscriber's garbage bill is based on the capacity of collection containers he or she sets out to be emptied into the garbage truck each week. However, the economic disincentive for setting out more containers or a larger capacity container varies substantially among the cities. For example, one of the sixteen cities does not even use variable can rates.

Figure 1 shows an example of each type of garbage collection fee schedule used in King County:

- ◆ Unit-based incentive rates (Seattle)
- ◆ Cost-of-service rates (Bellevue)
- ◆ Flat rates (Kirkland)

Figure 1



Four of the sixteen cities – Auburn, Issaquah, Redmond, and Seattle – charge at least as much for additional 32-gallon cans as for the first. Seattle's unit-based fee structure is illustrated by the green line in Figure 1, showing monthly fees, including taxes, of \$16.10 and \$32.15 for weekly collection of one or two 32-gallon cans, respectively. Seattle's microcan and minican 10- and 20-gallon service levels cost, re-

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spectively, \$10.05 and \$12.35, including taxes.

Redmond and Seattle charge about the same fee for additional 32-gallon cans as they charge for the first, while Issaquah and Auburn charge more. For example, Auburn charges 1.21 times as much for the second 32-gallon can as for the first.

The purple line in Figure 1 illustrates the cost-of-service rate structure. Bellevue charges \$8.21, \$14.39 and \$19.87, including taxes, for collection of a 20-gallon minican or one or two 32-gallon cans, respectively.

Strict cost-of-service rates impose a fee for additional 32-gallon cans that reflects only the extra collection and disposal costs incurred for emptying more than one 32-gallon can of garbage from a single household. Cost of service rates in effect give a volume discount for additional amounts of garbage, based on efficiencies achieved when more waste is collected during a single stop.

Eleven of the sixteen cities use a cost-of-service approach in setting their garbage fees. In these cities second can charges vary between 33% (Woodinville) and 59% (Renton) of first can fees. Those cities at the lower end of this range more closely follow the strict cost-of-service approach traditionally used by the Washington Utilities and Transportation Commission (WUTC) in setting garbage fees for haulers operating in geographic areas of the state subject to WUTC rate regulation. Cities at the upper end of this range have modified their fee structures somewhat to provide more incentive to reduce and divert waste.

The red line in Figure 1 illustrates the flat-rate user fee structure. Kirkland charges a monthly fee of \$18.70, including taxes, for collection of garbage from whatever number of cans the household wishes to set out each week.

This flat-rate fee structure minimizes billing and on-route record keeping complexities introduced by the variable-can rate structures illustrated in Figure 1 for Seattle and Bellevue. However, it provides much less economic incentive for waste reduction or diversion.

Garbage Bills

Average garbage collection bills, including taxes, range between \$12.58 in Renton and \$24.32 in rural Duvall, averaging \$18.18 across the sixteen cities. Charges for a single 32-gallon can, including taxes, range between \$10.11 in Redmond and \$21.56 in Duvall, averaging \$14.11 across the surveyed cities.

The incremental charge for the second 32-gallon can averages 51% of the first can charge, ranging between Kirkland's no additional charge and Auburn's 121%. The occasional extra unit of garbage carries an average \$3.65 charge, ranging between no charge in Kirkland and \$9.11 in Auburn.

Garbage, Recycling and Yard Waste Quantities

Table 1 shows summary data on 1998 collection quantities for total solid waste (garbage, recycling, and yard debris) and the garbage component. Table 1 also lists weekly garbage container capacity and weight per container, expressed in 32-gallon can equivalents.⁴

As indicated in the table, annual solid waste collection ranges from 1.17 tons per household in Seattle to 1.96 tons per household in Mercer Island, averaging 1.55 tons across the sixteen cities surveyed. Given these rankings for waste generation it is perhaps no surprise that Seattle is tied with Tukwila for lowest median income among the sixteen cities, while Mercer Island ranks highest with median income double that for Seattle and Tukwila.

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**Table 1
1998 Solid Waste Collection**

	Waste Collected		32-Gallon	Lbs.
	Per Household		Cans Per	Per
	Total	Garbage	Household	Can
Average	3,096	1,672	1.35	24.0
Low	2,331	1,056	0.99	17.8
High	3,911	2,291	1.67	36.8

Seattle also has the smallest average single-family lot size, estimated at 0.14 acres or 6,280 square feet. Mercer Island, along with Woodinville, ranks at the top with lots averaging 0.39 acres, over 17,000 square feet. Other factors being equal, one would expect communities with bigger lots to generate more yard debris, increasing the amount of waste set out for collection, whether in the garbage can or in a separate yard debris collection container.

Collection quantities for the garbage component of solid waste range from 0.53 tons per household in Seattle to 1.14 tons in Auburn and SeaTac, averaging 0.84 tons in the cities surveyed. The other two components of collected single-family waste, curbside recycling and curbside yard debris, account for nearly 46% of solid waste on average in the sixteen cities, ranging between 9% in SeaTac and 61% in Mercer Island.

In terms of per household garbage quantities it is important to note that Seattle uses unit-based garbage fees and no-additional-charge curbside recycling. Seattle also rigorously enforces its ban on collection of yard debris in residential garbage, and charges a subscription fee for yard waste collection that is low in comparison to the incremental charge for a second 32-gallon can of garbage.⁵

Auburn and SeaTac, on the other hand, are the only two cities that do not offer curbside recycling at no additional charge for garbage collection customers. SeaTac charges a subscription fee, while Auburn relies

on an extensive network of recycling drop-off sites, 18 in all, or one for every 1.1 square miles within the city.

Finally, Table 1 shows that the sixteen cities averaged 1.35 32-gallon cans of garbage per household, with an average weight of 24.0 pounds in each can. Seattle came in lowest in cans per household at 0.99, while Mercer Island households were highest at 1.67.

Mercer Island at 17.8 and Bellevue at 18.2 ranked lowest in weight per can, while Auburn ranked highest at 36.8. This latter result is perhaps no coincidence given that Auburn has unit-based garbage fees that increase sharply for increasing amounts of garbage, yet offers no curbside recycling and provides yard waste collection only on a separate fee, subscription basis.

Seattle itself averaged 20.6 pounds per 32-gallon can, 14% below the sixteen-city average and well below an amount that would justify the accusation that Seattle's unit-based variable can rates cause a "Seattle Stomp". Seattle households have plenty of convenient, affordable methods for diverting waste that obviate their having to resort to jumping on the contents of their garbage containers on collection day.

Detailed Results for Regression Equations

Table 2 lists multivariate regression estimates for the quantitative impacts on garbage, recycling and yard debris collection quantities caused by garbage fees, garbage fee structures, income, yard debris collection charges, lot size, and lack of curbside collection.

Most of the column headings in Table 2 are self-explanatory. Garbage Bill at the head of the third column refers to a city's average garbage bill. 2nd Can Fee is the incremental charge for the second 32-gallon can of garbage. Relative Income is the ratio of a city's median income to the av-

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Table 2
Regression Coefficients

	Con-stant	Garbage Bill	2 nd Can Fee	Relative Income	Relative Y Fee	Lot Size	Sub R Only	Drop R Only	Drop Y Only	Y No Charge	R ²	N
Garbage Per Household	1290.5 (237.4)	-22.9 (11.4)	-26.5 (9.4)	717.9 (177.9)	184.7 (48.5)	n.s.s.	569.5 (120.9)	965.3 (123.8)	446.5 (141.4)	n.a.	.92	16
Log(Garbage Per Household)	7.206 (0.154)	-0.016 (.007)	-0.020 (.006)	0.478 (.115)	0.107 (.031)	n.s.s.	0.296 (.078)	0.564 (.080)	0.298 (0.092)	n.a.	.89	16
Recycling Per Household	n.s.s.	n.s.s.	n.s.s.	746.4 (32.1)	n.a.	n.a.	-485.8 (128.5)	-568.9 (128.3)	n.a.	n.a.	.97	16
Yard Debris Per Household	n.s.s.	43.5 (7.4)	n.a.	n.s.s.	-171.3 (84.1)	n.s.s.	n.a.	n.a.	-718.4 (244.6)	395.6 (131.0)	.96	16
Yard Debris Per Household	n.s.s.	37.3 (9.7)	n.a.	n.s.s.	-409.7 (53.1)	1489.0 (562.3)	n.a.	n.a.	-876.2 (201.1)	n.s.s.	.97	15

Note: n.s.s. = not statistically significant; n.a. = not an appropriate variable for this equation.

erage for median incomes in the sixteen cities.⁶

Relative Y Fee is the ratio of a city's charge for curbside yard debris collection⁷ to that city's incremental charge for the second garbage can. Lot Size is average acres per occupied single family residence in a city.

Sub R Only is an indicator variable for SeaTac which is the only city of the sixteen to provide curbside recycling only on a subscription basis. Drop R Only is an indicator for Auburn, the only city to offer no curbside recycling.

Drop Y Only is an indicator variable for Duvall, the only city to offer no curbside yard debris collection. Y No Charge is an indicator variable for those seven cities that offer curbside yard debris collection at no additional charge.

The entries in the cells of Table 2 show estimated regression coefficients for the variables listed in the column headings. These coefficients give each variable's quantitative impact per unit on annual household collection quantity for each solid waste collection component shown in the first column. The standard error for each regression coefficient estimate is shown below it in parenthesis.⁸

Quantified Antidotes to Disposal and the Stomp

The coefficient estimates shown in Table 2 indicate that cities have considerable influence over their single-family residential diversion levels. Most of these influences were summarized at the beginning of this article.

What is worth emphasizing here is the stability of the quantitative estimates for these influences shown in Table 2. This stability, along with the high explanatory values for all equations as shown in the R² column of Table 2, provides confidence the statistical results of this study are accurate and reliable.

To test stability, the garbage collection equation was estimated in two commonly used forms – linear and log linear. Both equations yielded coefficient estimates with the same signs and similar magnitudes in terms of impact on garbage collection quantity.

As another test of stability, the yard debris collection equation was estimated over the whole sample and then over a subset that excluded Kirkland. That city's average lot size ranks at the bottom just above Seattle. Yet Kirkland's collection of yard debris ranks in the top three along with Mercer Island and Bothell.

Removing the Kirkland outlier yielded a statistically significant coefficient for the impact of lot size on yard debris collection. It also gave a better estimate of the impact on yard debris collection of the relative charge for yard debris, one that no longer required estimation of a separate impact for those cities which offer yard debris collection at no additional charge. At the same time, the estimated impacts of garbage fee levels and not providing yard debris collection at all remained within the same bounds.

Finally, it is worthy of note that all coefficient estimates reported in Table 2 conform to the predictions of economic theory. That is, higher prices for collection of a particular solid waste component cause households to buy less collection services for that component, either by reducing waste or by switching some of their waste into one of the other collection streams. Also, higher incomes cause households to consume more stuff, generating more waste for management in the garbage and recycling collection streams.

About The UnEconomist

This monthly online newsletter intends to provide insight and analysis on the everyday economics of recycling and the unpriced or underpriced environmental benefits of reducing waste disposal and replacing virgin-content products with products manufactured from recycled materials. Reader feedback is encouraged via email to info@ZeroWaste.com, and substantive comments will be published whenever they add to our understanding of recycling.

The UnEconomist also analyzes recycling market prices in the Northwest and Northeast for the eight or nine recyclables tracked by graphs available online at www.SoundResource.com. These graphs are updated at least every other month. The UnEconomist will from time to time report on the accuracy of the five-year recycling

price forecasts that are provided on each recycling market price history graph.

¹ The group of residential garbage collection service customers living in single-family and smaller multi-family structures and using can or wheeled cart garbage containers is often called the single-family residential sector. This nomenclature distinguishes these customers from households living in bigger apartment buildings with garbage collection service using detachable containers (“dumpsters”). The latter group of households is typically called the multi-family residential sector.

² Cities included in the sample are Auburn, Bellevue, Bothell, Des Moines, Duvall, Federal Way, Issaquah, Kent, Kirkland, Mercer Island, Redmond, Renton, SeaTac, Seattle, Tukwila and Woodinville.

³ In this article the wide variety of household garbage collection container types used for collecting trash in the sixteen cities is simplified by referring to different garbage collection service levels in multiples of 32-gallon cans. This is done both for convenience of exposition, and because the additional (“incremental”) charge for the second 32-gallon unit of garbage turns out to be a significant driver of waste disposal reduction and diversion levels, regardless of whether that 32-gallons of garbage is placed in a 60- or 64-gallon wheeled cart or a second 32-gallon can. The statistical analysis is not biased by this simplification. It also avoids presenting awkward and lengthy detail on whether a particular city offers collection for volumes of garbage in excess of 32 gallons only through use of additional 32-gallon cans, or also provides service levels for 35-gallon, 60- or 64-gallon, and/or 90- or 96-gallon wheeled carts.

⁴ 32-gallon can equivalents are calculated for each city by summing up weekly garbage container capacity (10 and 20-gallon minicans, 32-gallon cans and 35-gallon carts, 60- or 64-gallon carts and 90- or 96-gallon carts) for all single-family residential garbage collection customers. This total gallons figure is then divided by 32 to obtain total 32-gallon can equivalents. Finally, this total 32-gallon can equivalents figure is divided by number of garbage collection customers to obtain the estimate of average weekly 32-gallon can equivalents used by each garbage collection customer in the city.

⁵ In 1998 Seattle charged \$4.25 per month for separate collection of unlimited amounts of yard debris, just 26% of the charge for a second 32-gallon can of garbage.

⁶ The average for median household income across the sixteen cities was \$50,375 in 1994, the most recent year for which income data was available for all King County cities. The ratio of a city’s median in-

come to this \$50,375 average was used in the regression equations on the assumption that this same ratio for 1998 incomes for each city would not be substantially different. If this assumption holds, then the estimate of income's effect on disposal and diversion shown in Table 2 is as accurate as it would be using 1998 income data..

⁷ A city's yard debris collection charge is 0 for cities with yard debris collection embedded in garbage fees.

⁸ A cell in Table 2 has the entry n.s.s. , meaning not statistically significant, for estimates that had "too large" standard errors. The criterion defining "too large" is that the probability that a coefficient could be zero or have the wrong sign had to be less than 10% or else the coefficient was n.s.s.