The Monthly UnEconomist

It's Not the Seattle Stomp Anymore! – Part Two

An August 1993 front page article titled "Trash Dance" in *The Wall Street Journal* opined that Seattle's garbage-by-the-can incentives to induce residents to recycle had instead resulted in human trash compacting. "You climb in, jump around, and eventually it all fits in one can," the article quoted one resident saying as she danced the "Seattle Stomp" in her garbage can on garbage night.

The WSJ article's conclusion was premature, if there ever was a time in Seattle when it was close to the truth at all. The *UnEconomist* reported last month that Seattle's 32-gallon garbage can weighed less than 21 pounds on average in 1998. Annual garbage collection per household averaged just over half a ton, lowest among sixteen King County (Washington) cities surveyed. Residential garbage collection per household in Seattle and choice of number and size of garbage cans have all been relatively stable since 1993. So the Seattle Stomp was a fiction even as the WSJ reporter watched his carefully orchestrated resident do her trash dance.

The point in mentioning WSJ inaccuracies in garbage reporting is not to pillory that newspaper, but to emphasize the paucity of statistically valid data behind many of the attacks on recycling that appear too often in print. Societal reform movements such as recycling always engender harsh criticism. However, such criticism should be based on fact rather than *a priori* opinion and prejudiced example.

Summary of Additional Results on Waste Weights and Garbage Rates in King County Cities

Conclusions reported in this article are based on statistical analysis of 1998 single-family residential solid waste collection quantities and user fees from sixteen King County cities, a study that was initially discussed in September's *UnEconomist*. That September article focused on the impacts of economic variables such as price and income on garbage, recycling and yard debris curbside collection quantities. This month the *UnEconomist* discusses additional statistically based conclusions regarding success factors for diversion programs and effects of economic variables on waste reduction, garbage service levels, and amount of garbage placed in each garbage can.

Important results detailed here include:

- Collection frequency is very important in achieving higher diversion rates for recyclables, but whether those recyclables are source separated or commingled in household collection containers is insignificant.
- There are significant negative impacts on waste reduction (in terms of both garbage generation and management of yard debris at home through, say, backyard composting) when curbside yard debris collection is provided at no additional charge to garbage collection customers. At the same time, instituting a separate charge for curbside yard debris collection can decrease residential recycling rates by more than eleven percentage points, if that separate charge is too high relative to the fee for weekly collection of a second 32-gallon can of garbage.
- Higher income households generate more garbage. They also buy more garbage collection services, by subscribing for additional or bigger cans or carts. As a result, it is not obvious *a priori* whether higher income households will put more garbage in each can. This study reveals that current income, longer-term wealth, as well as several pricing factors determine how much garbage is placed in each can on average in any given city.
- Fees charged for the second weekly can and for the occasional extra bag of garbage have a substantial impact on can weights. These fees are the "garbage stomp" factors, but they are completely mitigated when reasonably priced or no-charge diversion options are equally as convenient as garbage collection.
- Lot size is a significant factor in customer choice of garbage service level, but the charge, or lack thereof, for yard debris collection is not.

- The yard waste fee is a significant determinant of garbage can weight, whereas lot size is not.
- City rankings of garbage per household adjusted for income and lot size provide further strong evidence of the importance of economic incentives in minimizing garbage disposal. Those rankings, displayed in Table 2, clearly reveal that cities with lower garbage generation per household succeed at garbage minimization by bundling costs for curbside collection of recyclables and yard debris in their garbage fees. Furthermore, cities get an extra boost in garbage minimization by structuring their garbage rates to increase at least in proportion to increases in the amount of garbage being set out for collection.

Do Collection Frequency or Commingling Matter for Recycling?

There is an ongoing debate between the proponents of weekly, source-separated curbside recycling and those supporting less frequent (biweekly or monthly), commingled collection. In fact, when Seattle introduced citywide curbside recycling more than ten years ago, weekly source separation was implemented in half of the city and monthly commingled in the other half. The other fifteen King County cities surveyed for this study are almost evenly split between cities that recycle every week and those that recycle biweekly or monthly. Also, not all cities offering less frequent collection use commingled recycling. This diversity allows the effect of less frequent collection to be measured separately from the effect of commingling.[1]

The equation for recycling per household in Table 1 shows that recycling collection frequency, measured in weeks per year, has a statistically significant and substantial effect on quantity of material collected in a curbside recycling program. For example, weekly collection increases household diversion by 148 pounds annually compared with biweekly collection (26 pickups a year). This represents almost 22% of the sixteen-city average of 684 pounds recycled annually per household.[2]

At the same time, commingling is not statistically significant, and has a much less substantial 20-pound (3% of annual household recycling) negative impact on annual recycling levels.[3] Thus, in King County collection frequency is much more important than commingling or source separation in motivating high recycling rates.

As an example of the implication of these results, consider that Seattle currently provides monthly, commingled recycling to the 53% of single-family through fourplex-apartment garbage collection customers living in the south half of the city. Weekly, source-separated recycling is offered to the 47% in the northend. In the spring of 2000 Seattle will switch to biweekly, commingled recycling citywide, cutting collection frequency by 26 weeks in the north and increasing frequency by 14 weeks in the south. Based on the statistical results reported here, one would predict that this net decline in Seattle's overall collection frequency will decrease curbside recycling tonnage by about 3%, cutting the residential recycling rate about one percentage point.

Increased collection efficiency and decreased collection truck traffic in Seattle neighborhoods are probably worth risking a potential small decline in recycling. Furthermore, southend households currently use a collection container that many claim provides too little storage capacity. The increase to biweekly collection in the southend may capture recyclables currently being thrown in the garbage after the recycling container fills up between monthly pickups. This would at least partially offset the predicted decrease in recycling from reducing overall curbside recycling collection frequency in Seattle.

Does No-Additional-Charge Yard Debris Collection Increase Waste Generation?

Last month's *UnEconomist* reported that bundling (i.e., embedding) the cost for recycling and/or yard debris collection in with garbage collection fees yields a significant and substantial increase in the amount of waste diverted from garbage collection and disposal. Some

Table 1
Regression Coefficients

	Constant	Garbage Bill	2nd Can Fee	Relative Income	Frequency	Relative Y Fee	Lot Size	Sub R Only	Drop R Only	Drop Y Only	Y No Charge	R^2	N
Garbage Per Household	1218.7 (122.7)	-28.9 (7.8)	n.s.s.	n.s.s.	n.a.	220.1 (58.7)	2124.0 (381.2)	475.1 (72.1)	514.4 (116.6)	792.3 (101.7)	150.7 (90.3)	.96	15[4]
Recycling Per Household	n.s.s.	n.s.s.	n.s.s.	521.6 (86.9)	5.7 (2.1)	n.a.	n.a.	-455.3 (105.9)	n.a.	n.a.	n.a.	.98	15[5]
Yard Debris Per Household	n.s.s.	31.7 (9.5)	n.a.	n.s.s.	n.s.s.	-291.9 (84.5)	1180.7 (549.1)	n.a.	n.a.	-677.2 (218.9)	222.6 (130.1)	.97	15[4]
	Constant	**Garbage Bill**	**2nd Can Fee**	**Extras Relative Price**	**Relative Income**	**Relative Wealth**	**Relative Y Fee**	**Lot Size**	**Sub R Only**	**Drop R Only**	**Y No Charge**	R^2	**N**
Log(No. of Garbage Cans)	n.s.s	n.s.s.	-0.023 (.006)	n.s.s	0.243 (.108)	n.s.s	n.s.s	0.814 (.333)	n.s.s.	n.s.s.	n.s.s.	.93	14[6]
Log(Pounds Per Can)	n.s.s	n.s.s	0.128 (.015)	1.618 (.281)	1.881 (.353)	-1.045 (.243)	0.300 (.109)	n.s.s	n.s.s	n.s.s	0.487 (.167)	.99	14[6]

Note: n.s.s. = not statistically significant; n.a. = not an appropriate variable for this equation.[7]

question the wisdom of offering curbside collection, especially for yard debris, at no additional charge to garbage collection customers. Free (from the garbage customer's point of view) yard debris collection reduces waste prevention and reduction incentives. For example, the customer may cease to invest time in backyard composting or grasscycling activities once yard debris collection is made available at no charge beyond the amount paid for garbage collection.

The garbage and yard debris equations in Table 1 provide estimates of waste reduction impacts resulting from no-additional-charge yard debris collection at the curb. To understand what these waste reduction impacts are, first note that both garbage collection and yard debris collection equations contain the variable Relative Y Fee. This variable is computed by dividing the fee charged for yard debris collection by the fee charged for weekly collection of a second 32-gallon can of garbage. For cities offering free yard debris pickup, this relative price is zero. For cities in which the yard charge is more than the fee for a second garbage can, Relative Y Fee is greater than one.

According to estimated coefficients for Relative Y Fee, garbage collection is lower and yard debris diversion is higher by a statistically similar amount between 220 and 292 pounds[8] when the yard debris pickup charge is zero. As the relative price for yard debris increases from zero, more yard debris stays in the garbage can and less is set out for separate collection by the yard debris recycling truck. This decrease in yard debris recycling as the relative fee for yard debris collection goes up can be interpreted as the "price effect" of charging for yard debris collection.

In addition, coefficient estimates shown in Table 1 for the Y No Charge variable in the garbage and yard debris equations can be interpreted as the "income effect" of providing free collection. The Y No Charge variable takes the value one for cities that do not charge, and the value zero for cities that do charge, an additional fee for yard debris collection.

To understand this "income effect," note that giving garbage collection customers yard debris collection service at no additional charge actually increases their real income. They can consume the same amount of goods and services at lower total cost than if they had to pay for yard debris collection or spend time managing yard debris in a backyard composting system.

Another way of saying the same thing is that garbage customers can get more goods and services at the same total cost than they could if they had to pay for yard debris collection. As a

result, garbage customers with free yard debris pickup will tend to reduce the amount of effort they expend managing their yard debris at home, and increase the amount of money they spend on other goods and services, thereby increasing the amount of waste they generate.

The garbage equation in Table 1 estimates that this "income effect" amounts to 151 pounds of increased annual garbage generation, after adjusting for garbage fee levels, the relative charge for yard debris collection (the "price effect"), and yard size. This 151 pounds accounts for almost 10% of average annual garbage collection per household for the seven cities not charging for yard debris collection.

The yard debris equation estimates that those cities that provide collection at no additional charge pick up 223 pounds more yard debris annually from each household.[9] This extra 223 pounds represents 20% of the yard debris collected in the seven surveyed cities (Bellevue, Bothell, Issaquah, Kirkland, Mercer island, Redmond, and Renton) that do not charge garbage customers for curbside yard debris pickup.[10]

The waste prevention/reduction disincentive (the "income effect") from free yard debris pickup, thus, amounts to as much as 10% more garbage generation, along with as much as 20% more yard debris set out for curbside collection rather than being managed at home. On this basis, no-charge yard debris collection does have sizeable negative impacts on waste prevention and reduction in King County cities. On the other hand, as discussed in last month's *UnEconomist*, those cities that charge about as much or more for yard debris collection than they charge for weekly collection of a second can of garbage incur a residential waste diversion penalty of at least eleven percentage points.

One elegant answer to the yard debris recycling versus waste reduction tradeoff perhaps lies in a system like that used by Seattle. That city bans yard debris from garbage collection, effectively enforces that ban, and at the same time imposes a separate charge for yard debris collection that amounts to only 25% of the fee for weekly collection of a second can of garbage.

This yard debris fee may be enough to encourage substantial grasscycling and backyard composting of yard debris, while also being low enough to keep yard debris out of the garbage can. By contrast, for the other seven cities in the survey that charge for yard debris, Auburn's yard charge is 56% of its second can charge, Federal Way's is 86%, and the remaining five (Des Moines, Kent, SeaTac, Tukwila and Woodinville) cities' charges average 172%.

What Determines Number of Cans and Can Weight?

Statistical analysis of waste weights and garbage rates for King County cities revealed a number of other interesting relationships. The last two rows in Table 1 show the equation estimated for number of 32-gallon garbage can equivalents[11] used for garbage collection in King County cities, and the equation estimated to explain the weight of garbage placed in each can.

The natural log form for the equations fit the data best. As indicated by Table 1, economic variables such as the fee for weekly collection of a second can of garbage and household income are important determinants of both garbage service level and can weight. Recall that they also were significant in explaining a good deal of the variation among cities in annual curbside collection quantities for garbage, recyclables, and yard debris.

Do Higher Income Households Stuff More Garbage in Each Can or Buy More Garbage Collection Service?

It turns out to be more than coincidental that Mercer Island households use the greatest number of garbage cans, 1.67 per week, with the least amount of garbage in each can, 17.8 pounds, among the sixteen King County cities, while also having the highest median household income. The sixteen cities surveyed averaged 1.35 32-gallon can equivalents of garbage per household, with an average weight of 24.0 pounds in each can. City median household incomes ranged between 75% (Auburn, Seattle and Tukwila) and

150% (Mercer Island) of the sixteen-city average for median household income.

As indicated by the last two equations in Table 1, median income is an important determinant of customer choice for both number/size of garbage containers (service level), and weight of garbage placed in each can. For example, with median income 50% higher than the sixteen-city average, Mercer Island households are estimated to use an extra 17% of a 32-gallon can, other factors being equal, compared with households in a city such as Bothell where median income equals the sixteen-city average.[12]

Households with higher incomes also generate more garbage according to findings reported in last month's *UnEconomist*. But whether higher income households will put more garbage in each can, simply set out more (or larger) garbage containers each week, or do some of both is not obvious *a priori*.

The equation for pounds per can depicts these opposing tendencies by including variables for both income and wealth -- where a city's relative wealth is measured by the ratio of average 1998 value for single-family homes in that city to the sixteen-city average home value. As shown by coefficient estimates listed in Table 1, pounds per can increases as relative income rises, but decreases as relative wealth goes up. The former effect is due to richer households generating more garbage as a result of consuming more goods. The latter effect is from richer households spending more money on garbage collection by signing up for a higher level of service (i.e., more or bigger cans or carts).

An example illustrates how these opposing tendencies may play out in a given city. Mercer Island households have the highest incomes and the most expensive homes among the sixteen cities. Mercer Island households are estimated to put almost six pounds less in each 32-gallon can, other factors being equal, in comparison to a city in which median income and average house value are both equal to their sixteen-city averages.[13] Thus, Mercer Island households buy enough additional garbage collection service to more than offset the higher amounts of garbage they generate, thereby lowering the amount of garbage in each can.

The Real Stomp Factors: Fees for Second Cans and Extras

The fee charged for weekly collection of a second 32-gallon can of garbage is another important determinant of both garbage service level and can weight. Households in cities where second can fees are $6 or less (Bellevue, Bothell, Des Moines, Kent, SeaTac, Tukwila and Woodinville) tend to use at least an extra 13% of a can, compared with households where the second can charge is $10 or more (Auburn, Issaquah, Redmond, and Seattle – the garbage-by-the-can cities). At the same time, households in cities with $10 second cans put an extra thirteen pounds of garbage in each can, other factors being equal to their sixteen-city averages, versus households in cities with $6 second cans.

At the extreme, in the city with the lowest second can fee (Woodinville at $4.45), other than Kirkland where additional cans incur no charge, households use an extra third of a can compared with households in the highest second-can-fee city (Seattle at $16.05). But, according to the pounds per can equation shown in Table 1, Seattle households would put fifty-five more pounds than Woodinville households in each can, if all other factors were at sixteen-city average levels in the two cities.

This result illustrates the importance of providing reasonably priced waste diversion options that are as convenient as garbage pickup, especially in cities where garbage fees increase at least in proportion to the volume of garbage set out for collection (the garbage-by-the-can cities). Here it is worth noting that the pounds per can equation estimates Auburn and Seattle average can weights at 42 and 21 pounds, respectively, compared with actual 1998 average can weights of 37 and 21, respectively.

Recall that Auburn's second can fee is 121% of the first can charge, while Seattle charges the same amount for each can. Auburn offers only drop site recycling, while Seattle provides curbside recycling at no additional charge.

Furthermore, Auburn charges $9 for the occasional extra bag of garbage, and Seattle charges $5. None of the other cities charge more than $4.25, and the extra charge averages just over $3 in these 14 cities.

As shown in Table 1, the Extras Relative Price -- the charge for an extra bag of garbage divided by the fee for weekly pickup of a second can – has a significant and substantial effect on the amount of garbage stuffed in each 32-gallon can. For example, those cities that charge $4 for an extra bag of garbage are estimated to have over four more pounds in each 32-gallon can, other factors being equal, versus those cities that charge just $3 for an extra bag.

Effect of Yard Size on Garbage Can Count

Yard size is the final significant determinant for number of garbage cans. This variable probably reflects both amount of yard debris generated by the household and family wealth.[14] Family wealth often is as important as a given year's income in determining family consumption of goods and services, and resultant waste generation. As indicated by the coefficient estimate for Lot Size in Table 1, an additional tenth of an acre in yard size beyond the sixteen-city average of .275 acres per house is associated with use of an extra 11% of a 32-gallon can for garbage collection service.

Effect of Yard Waste Fee on Can Weight

It should not be surprising, given the impact of yard debris collection fees on garbage and yard debris collection quantities, that yard waste charges also significantly impact the amount of garbage placed in each 32-gallon can. As is the case for yard debris and garbage collection per household, the yard debris charge has both an income and price effect on garbage can weights.

Interestingly, the estimated price effect on garbage can weights in those cities that do charge for yard debris collection is outweighed by the income effect in those cities that offer yard debris collection at no charge. As a result, estimated garbage weight per 32-gallon can for cities that charge for yard debris collection is not quite 23 pounds. This compares with 25 pounds in cities that offer yard debris collection at no charge. Other factors -- second can fee, extras relative price, relative income and relative wealth -- are assumed to be at their sixteen-city average levels in this comparison.

Reprise: It really is Economics that Drives Garbage Minimization!

Table 2 ranks the sixteen King County cities in descending order of average annual garbage collection quantity per household in 1988, after adjusting collection quantities for household income.[15] Table 2 also shows rankings for unadjusted 1998 garbage collection quantities, as well as rankings for garbage collection quantity adjusted for lot size.[16]

Holding median household income constant, Auburn had the highest average garbage collection quantity per household subscribing for garbage collection service in 1998. Mercer Island had the lowest income-adjusted garbage per collection service subscriber.

Along with garbage quantity rankings, Table 2 also lists the basic economic incentives used in each city to reduce garbage generation and disposal. The cities with the highest and second highest income-adjusted garbage generation, Auburn and SeaTac, were the only two cities that did not offer curbside recycling to garbage service customers at no additional charge beyond the basic fee paid for garbage collection. SeaTac offers curbside recycling only on a subscription (i.e., additional fee) basis. Auburn does not offer curbside recycling at all, relying instead on an extensive network of recycling drop-off sites, with a site located on average every 1.1 square miles within Auburn.

In terms of the economic incentive for curbside yard debris collection, all the high garbage collection quantity cities but one charge separately for yard debris collection, while all the low garbage quantity cities but one offer that service at no charge to garbage collection customers. The two exceptions, Kirkland and Seattle, are each unique in their own way. Kirkland charges

Table 2
Rankings for Garbage Collection Per Household Compared with Diversion Incentives

City	Rank of Average Garbage Collection Quantity Per Household			1998 Average Garbage Collected Per Household	Economic Incentives for Diversion		
	Adjusted for Income	Adjusted for Lot Size	1998 Actual		Curbside Recycling	Curbside Yard Debris	Garbage Collection Fee Structure
Auburn	1	3	2	2270	Not Available	Subscription	Per Can/Incentive
SeaTac	2	1	1	2291	Subscription	Subscription	Cost of Service
Woodinville	3	5	3	2048	No Charge	Subscription	Cost of Service
Kent	4	8	5	1822	No Charge	Subscription	Cost of Service
Kirkland	5	2	4	1871	No Charge	No Charge	Flat
Des Moines	6	11	8	1583	No Charge	Subscription	Cost of Service
Tukwila	7	6	11	1518	No Charge	Subscription	Cost of Service
Duvall	8	4	6	1747	No Charge	Not Available	Cost of Service
Federal Way	9	10	7	1619	No Charge	Subscription	Cost of Service
Renton	10	7	14	1485	No Charge	No Charge	Cost of Service
Issaquah	11	9	9	1578	No Charge	No Charge	Per Can/Incentive
Bothell	12	12	12	1497	No Charge	No Charge	Cost of Service
Redmond	13	13	13	1492	No Charge	No Charge	Per Can/Incentive
Bellevue	14	14	15	1388	No Charge	No Charge	Cost of Service
Seattle	15	15	16	1056	No Charge	Subscription	Per Can/Incentive
Mercer Island	16	16	10	1544	No Charge	No Charge	Cost of Service

the same flat fee to all garbage service customers, regardless of the number or size of garbage containers any particular customer sets out for pickup on garbage day. This economic disincentive for garbage minimization offsets the no-charge yard debris incentive.

Seattle has a separate charge for yard debris. But that charge only amounts to 25% of the fee for weekly collection of a second 32-gallon can of garbage. By contrast, five of the other seven yard debris subscription cities impose a fee that on average amounts to 172% of their second garbage can fee. Auburn charges 56%, but offers no curbside recycling. Federal Way charges 86% of what it charges for a second garbage can and ranks lowest in garbage quantity among the cities other than Seattle that charge for yard debris collection.

In addition, Seattle has a very effective ban on collection of yard debris in garbage. According to Seattle waste composition data, over 90% of residential yard debris is diverted from disposal.

Finally, the importance of the third main economic incentive for garbage minimization is also demonstrated in the income-adjusted rankings for garbage quantity shown in Table 1. Cities that use incentive-based garbage fees – i.e., charging at least as much for weekly collection of additional 32-gallon units of garbage as is charged for collection of one 32-gallon can -- rank among the lowest garbage generating cities. The exception to this rule, Auburn, again is the city which does not offer any curbside recycling service.

About The Monthly UnEconomist

This monthly online newsletter available at www.SoundResource.com 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 northwestern and northeastern U.S recycling market prices for nine recycled materials (mixed paper, ONP, OCC, glass containers, tin cans, UBC, PET bottles, HDPE natural bottles, and HDPE colored bottles) 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 annually updated five-year recycling price forecasts that are also provided online for each of the nine materials.

[1] Source separation in King County means collection of recyclables from three bins holding, respectively, (1) mixed paper, (2) newspapers, and (3) commingled glass, metal and plastic containers. Commingled recycling means collection of mixed paper, newspapers, and metal and plastic containers from one bin, with glass containers collected either from a separate bin or from an insert hanging inside the bin for commingled materials. It is important to note that all curbside programs in the sample, whether source-separated or commingled, collect the same basic materials -- mixed paper, newspapers, cardboard, glass food and beverage containers, tin cans, aluminum cans, and PET and HDPE plastic bottles. The only differences are that a few cities also collect aseptic and gable top beverage containers and/or small pieces of scrap metal. These materials account for such a small portion by weight of total collected recyclables that they can be ignored without biasing the statistical results reported for this study.

[2] Interestingly, collection frequency impacts annual yard debris diversion per household by a similar magnitude -- about 135 pounds more yard debris is collected annually for weekly versus biweekly collection, other factors being held constant. This estimate is not reported in the yard debris equation shown in Table 1 because collection frequency was not statistically significant at the 95% confidence level in that regression equation. Excluding lot size, collection frequency was statistically significant at the 95% confidence level and yielded an estimated 5.2 pound increase in diversion for each additional week of annual collection frequency.

[3] The estimated effect of commingling is not statistically significant even at a low 60% confidence level.

[4] Sample used for this equation excludes Kirkland because lot size is an outlier relative to amount of yard debris collected in that city.

[5] Sample used for this equation excludes Auburn because that city does not offer curbside recycling.

[6] Sample used for these equations excludes Kirkland which does not charge for additional cans and Des Moines which did not provide garbage service can counts.

[7] 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 5% or else the coefficient was n.s.s. This is often referred to as a 95% confidence level.

[8] The estimated coefficient of 220.1 for Relative Y Fee in the garbage equation is statistically similar in absolute value to the estimated coefficient of –291.9 for relative Y Fee in the yard debris equation. This statement means that, given standard errors of 58.7 and 84.5 for each coefficient, respectively, one can not reject the hypothesis that the coefficients are of equal absolute magnitude.

[9] This estimate for the negative waste reduction impact of free yard debris collection is significant at the 94% confidence level. It, thus, falls slightly short of the 95% level attained by all other coefficient estimates included in Table 1, with the exception of the estimated increased garbage generation impact from free yard debris given in the garbage collection equation. That estimate is significant at the 91% confidence level.

[10] Duvall offers no-charge yard debris drop-off to residents of their city. Separate collection of yard debris at the curb is not available in Duvall.

[11] 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. Total gallons is then divided by 32 to obtain total 32-gallon can equivalents. Finally, total 32-gallon can equivalents is divided by number of garbage collection customers to obtain the estimate of average weekly 32-gallon can equivalents per household used in that city.

[12] It is interesting to note that the estimated equation for number of cans predicts quite well for the two cities at the extremes of the average garbage service level spectrum. Mercer Island averages 1.67 cans; the equation predicts 1.58. Seattle averages 0.99; the equation predicts 0.93.

[13] Bothell happens to be almost exactly average in both income and wealth.

[14] As indicated in Table 1, wealth as measured by a city's average 1998 value for single-family houses was not statistically significant in explaining number of cans. This could be due to the fact that yard size and property value tend to be positively correlated.

[15] 1998 household garbage collection quantities adjusted to hold income constant using the estimated coefficient from Table 1 in the September *UnEconomist* article.

[16] 1998 household garbage collection quantities are adjusted to hold yard size constant using the coefficient for lot size (measured in acres) reported here in Table 1.