

Recycling and Solid Waste Study:

How does Eugene, Oregon compare with other cities in the United States in terms of willingness to pay for recycling services?

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I. Problem identification:

In this paper we aim to determine how the city of Eugene, Oregon compares to other cities in terms of its citizens' willingness-to-pay (WTP) for recycling service. Also, we will determine what the expected WTP for Eugene residents and use that result to make policy recommendations. We use WTP as an indication of a city's relative valuation of recycling services in their community. In other words, we are assuming that someone with a higher WTP for recycling would be more likely to recycle. We will use WTP as the measure for consumer benefit (demand).

Consumer surplus is measured by consumers' WTP minus what he or she pays for the good, calculated across all consumers in a market. If, for example, Eugene has higher WTP than, say, Provo, Utah, a higher consumer surplus will be generated in Eugene than Provo—assuming comparable costs of recycling to said consumers.

Equally important to the cost-benefit study is a study of costs. We will examine the components of cost of waste and recycling collection and disposal. This will help us estimate of total social welfare. It is important to note that while consumer surplus is positive in Eugene's recycling industry, producer surplus is negative due to the \$5 rebate that is well below costs. This information is incomplete, however, because producers of the service use revenues generated from the solid waste market to pay for recycling. In that sense it is still informative to ascertain the cost of recycling to determine total social welfare equal to the sum of consumer and producer surplus.

So combining the cost of providing services in certain cities with WTP data as a measure of consumer surplus results in different optimum recycling levels. A resulting policy implication

is that recycling programs are more worthy endeavors for municipal governments with such high levels of WTP.

The existing political economy most likely has an important effect on a citizen's WTP. For instance, the state of Oregon has a goal of a 50% recovery rate of waste. Lane County's similar goal is set at 54%. Such an overwhelming sentiment that recycling is a good—in the altruistic sense of the word—goal should increase a citizen's WTP. An enthusiasm for recycling in Eugene has clearly manifested in a high price of waste disposal in addition to a “rebate” for recycling, both of which have been set by the city. Examining such attitudes towards recycling can help city planners, mayors and other policy makers decide what types of recycling services to employ and to what extent they should employ them.

II. Hypothesis development

Kaplan and Aadland conducted a survey of over 4,000 households across the United States aimed at determining whether or not individuals would be willing to pay a given amount for recycling services in their city using a double-bounded dichotomous choice contingent valuation survey. The survey asked a wide range of questions aimed at identifying telling characteristics of each respondent. These included age, gender, educational attainment and affiliation with environmental organizations. The purpose was to determine which of the many characteristics in question correlated significantly with WTP for recycling services. A detailed discussion on CVM is included in section entitled “Classifying Valuation Methods” later in this paper.

There is an interplay between recycling and refuse services, where the latter is a substitute for the former. Municipal solid waste collection and recycling are businesses, subject

to the same economic laws and tendencies of any other type of industry. Solid waste and recycling services are *bona fide* products, saleable and purchasable on a market. Recycling is a substitute for refuse in that consumers choose which service to utilize whenever they discard material (assuming that the material *can* be recycled). The cost of each service affects its demand, as does the price of its substitute (cross-price elasticity). What we seek is to ascertain how living in the city of Eugene affects an individual's WTP for recycling.

We hypothesize that the Eugene dummy variable will prove to be significantly positive because recycling is considered an environmentally conscious activity. We believe that Eugene's record of environmental and social activism points to a high likelihood of preferring environmentally oriented policies.

We speculate that WTP and participation are highly positively correlated in the voluntary and no recycling program cities. Where it is mandatory, the personal impetus may be confounded with the compulsory nature of the program and therefore may not have as strong of a positive correlation.

III. Literature Analysis & Review

In addition to recognizing Eugene's historical and political attributes it is also worth assessing the industries of Municipal Solid Waste and Recycling. First, we look at the setup of the MSW and recycling industries and the respective market failures that result from their organization. Specifically, we will look at how the industries often produce natural monopolies. We will also examine contingent valuation method (CVM), a means of extracting a citizen's WTP. Finally we will examine the cost of MSW and recycling.

These industries and their pricing policies can yield high or low recycling rates, high and low pollution rates, and other environmental related consequences. Eugene has an unusual refuse policy in that it charges for it on a per quantity basis. As Richard C. Porter writes in The Economics of Waste, “in the vast majority of cities where some kind of collection is provided, its cost is covered either from general revenue funds or from a flat charge on residents, where by flat charge is meant a charge that is not related to the amount of trash that is put out for pickup (Jenkins 1993; Porter 39).” The response to such a pricing scheme follows economic theory—the market will be inefficient. The U.S. has seen sharp increases in waste generation since, say, 1960. That year 2.68 pounds of waste per person per day was generated, whereas in 1998 that number was up to 4.46 pounds.

It is important here to define what exactly comprises “waste.” Porter cites the Resource Conservation and Recovery Act of 1976, which defined it as “any garbage, refuse, sludge from a waste treatment plant, or air pollution control facility and other discarded material including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities.” For our purposes, however, we wish to see changes in generation of *municipal solid waste*, which is “the trash of households and small businesses that is picked up by municipalities or by private waste haulers (Porter 3).” In total, 200 million tons of waste is generated each year, 40% of which is created by said small businesses.

Two main categories comprise the cost of waste collection, which can be classified as private and external. Private costs consist mainly of “wages, fuel, machinery and land” whereas external cost is comprised of “reduced highway safety, added street noise, increased traffic congestion, and more air pollution (40).” Clearly, a failure to price such costs imposes

inefficiencies in the market and yields a quantity of waste that far exceeds the socially optimal quantity, that is, where price equals marginal social cost (marginal external cost plus marginal private cost). Porter sums up such a failure well: “When price does not cover marginal cost, we introduce a largely unintended subsidy to waste generation and thereby induce households to create too much waste. Or when price does not cover external costs... we foist waste collection costs onto third parties and thereby further induce households to generate too much waste. (40)”

A river provides a good example of how costs can become external. Waste dumped into a river imposes costs not only at the dumpsite, but anywhere downstream. Similarly, costs are imposed when waste surpasses a socially optimal level. External landfill costs include threats to groundwater, odor, noise, litter, and emissions of methane, a greenhouse gas. Such costs of inefficiently priced waste can in fact be quantified. Empirical studies find estimates of the volume of MSW (mentioned above as 4.4 pounds per person per day); the marginal social cost of collection and disposal, estimated at \$.05 a pound or \$100 a ton (Repetto et. al. 1992; Stevens 1994); and the price elasticity of demand of -0.2 (Goddard 1994 etc.). Using these estimates, Porter calculates deadweight loss in the industry of \$3.5 billion per year.

To reach optimal levels it is then examined how such charges should be levied. The two main options include advance disposal fees on the manufacturer or a waste disposal charge, but we know that economic theory dictates that, regardless, the consumer will bear such a cost. This being said three ways possibilities arise in pricing: (1) “Priced tags, where the households must buy specially marked tags and apply them to its usual plastic trash bags (2) Priced bags, where the household must buy specially marked bags and use only them to set out its trash for pickup and (3) Subscription cans [which Eugene employs] where each household must contract for a certain number and size of trash cans and stay within that limit for each pickup.”

It may serve useful to glance at the historical progression of trash pickup:

For rural areas or small towns, especially in developing countries, household trash collection is usually optimal. Any health or aesthetic costs of inadequate disposal are largely borne by the household itself. As cities grow, however, income, density, and waste also grow. Ill-disposed waste begins to generate ever larger external costs. At some point, these external costs become so great that city dwellers begin to require the proper disposal of waste. Some households do it themselves, making a weekly trip to ‘the dump,’ but competitive private sector collectors also begin to appear; some even work for free to get garbage to use for animal feed. Eventually the illogic of having several collectors combing through the same routes becomes so apparent—at least in most U.S. municipalities—that a monopoly collector, either public or private is chosen.

Porter

This story leads to an examination of the MSW collection industry and how economies of scale arise. This leads us to believe that a natural monopoly would be the most likely circumstance (see appendix). Eugene, however, reveals that theory is not always put into practice.

A survey of Oregon’s twenty largest cities shows that 16 of such cities operate under the expected “exclusive franchise” service arrangement in which “franchised haulers provide service exclusively within a designated territory, most often throughout the entire city. Eugene is the only city that uses an “operating permits” system in which “permitted haulers compete with other haulers for accounts,” which effectually allows more than one hauler to collect on the same block. We should note that in practice in Eugene, one hauler does in fact command a significant majority of the market. Other methods for collection include municipal service, where “crews employed by the city provide the service” and non-exclusive franchises, where “franchised haulers either compete with other franchised haulers or provide service within a designated territory.” Of the cities surveyed, none employed the former and three employed the latter system.

From MSW stems recycling, and an examination of the industry is in order. Recycling and waste are inextricably linked. What we do not throw away we most likely recycle and what we do not recycle, we most likely throw away. It is important, then, to examine how such decisions are made. Porter notes that the zero price policy that so often is the case in waste and recycling markets yields a market failure. “With discarding, neither the costs of MSW collection nor the costs of the landfilling, neither the private costs nor the external costs, are taken into account in the zero price. And with recycling, the zero price there does not reflect the collection and sorting costs, nor does it consider the social benefit of recaptured material. (Porter 122).” Porter goes on to note that, “Whenever recycling provides a net social benefit in comparison with landfilling or incinerating the waste, a working market should send a signal to the household to that effect. The basic market failure in recycling is that no such signal is sent.” We have no incentive to choose recycling over discarding; due to the fact that it takes more time to recycle materials (due to sorting) than it does to discard, people thus have a disincentive to recycle.

Why recycle in the first place? A detailed examination of the subject would yield an entirely different paper, but one simple, yet important reason to keep it in place is the future. Taking the example of a sort of ore, with recycled as an alternative to virgin ore, Porter explains. “While ore is cheap, we are using lots of it, living high off of the hog, but as cheap ore sources are used up, we find ourselves spending ever more time and resources just to uncover ore and our living standards decline...if we want an intergenerational smoothing of living standards we must choose to begin recycling earlier than absolutely necessary. (126)”

Because, however, this is an economic based paper, and not a philosophic one, we will examine its costs and benefits and consider what factors do, or at least could, go into WTP decisions. Three major benefits and two major costs go into such a cost-benefit analysis: “the

recovery and reuse of materials, the reduced use of a landfill (or incinerator), and the reduced need for solid waste collection” are some of the benefits. The costs are comprised of “collecting recyclable materials and processing the materials for reuse. (133)” Empirically, it has been found that while increased recycling does reduce landfill costs, reductions in MSW collection costs are negligible (even if each household disposes less, trucks must still stop at each house).

Just as with MSW we must decide which recycling policies will elicit the type of response that would be socially optimal. Porter describes three techniques. The first is “an advance disposal fee, levied either on the manufacturer at the time of production or on the consumer at the time of purchase.” Next he mentions “a trash collection charge (or refund) levied on the household at the time of disposal of the package or the remnants of the product itself... and [finally] a recycling collection charge (or refund) levied on the household when materials are put out for recycling. (149)” Porter notes that differences lie in whether or not illegal disposal is taken into account, but concludes that the second of the three is the best. Palmer, Sigman and Walls examine three similar strategies in “The Cost of Reducing Municipal Solid Waste.” These are comprised of a deposit/refund pricing policy, an advance disposal fee (ADF), and a recycling subsidy. The state of Oregon employs the first of these policies while Eugene employs the third. In estimating the effectiveness of such policies, Palmer et al. find that reducing the waste 10% would cost an estimated \$45 per ton in the deposit/refund approach as compared with 85\$ for an advanced fee and \$98 for a recycling subsidy. The reason for such differences in costs are due to the differing effects of the policies on 1) source reduction and 2) recycling increase. Whereas a deposit/refund approach affects the desired response in both areas, results from the other two policies are limited to either source reduction (for the advance disposal fee) or a recycling increase (for the recycling subsidies). However, the study notably does not

include the administrative costs of implementing the respective policies, an omission that could potentially alter the results.

Palmer et al. also compare the costs of “policies that set common waste reduction targets for specific materials with a least-cost approach that allows greater reductions in some materials than others (129).” Because consumers of the five materials targeted for waste reduction (paper, glass, aluminum, steel, and plastic) respond dramatically different to the aforementioned policies, the study finds that the “least-cost approach” is more efficient than requirements for each of the respective materials.

Problems come into both the recycling and refuse sector when we introduce the problem of illegal dumping. The schemes mentioned above like priced tags, priced bags, and subscription cans, in addition to recycling pricing policies, lose their effectiveness when customers can dispose of all waste at no cost. Thus, as Porter writes, “If households can litter without costs to themselves, then they must be induced through subsidies to dispose of trash and recyclables by more desirable means. An advance disposal fee must be added to the product... and refunds must be offered for both trash disposal and for recycling. (154)” This often precludes any reuse of a product because of the new incentive to fill up a garbage can or recycling can.

Porter also recognizes that both supply and demand side policies may be employed, though he notes that supply-side policies are certainly optimal. It is a supply-side problem in the sense that households do not supply enough waste for recycling because waste disposal is often free. Imposing a price would then be a supply-side remedy. Demand-side on the other hand takes into account demand for recycled materials and “seek to artificially raise the price of recycled materials (161).”

Porter also introduces the concept of co-collection, which is known in Eugene as commingling and elsewhere as single stream. Such a policy removes the labor of sorting for households in that all materials, except glass, can be placed in the same container. This yields large increases in participation but higher costs of recovery.

From an economic standpoint, the future of recycling—and the policies that rest upon it—depends upon technological improvements. As noted, a failure to price garbage correctly generates waste total in excess of the optimum quantity. Such a failure to price garbage collection results in part from the fact that it is cheaper to collect than recycling. This fact is due to the significantly greater amount of material (three times as much) that a garbage collection truck collects in comparison with a recycling collection truck. Why? Because of the ability to compact waste material and not recycled material (Porter 136). Until recycling facilities can recover compacted materials, the average cost of recycling collection will never approach that of waste collection. There will be no economic incentive for cities to price waste higher than recycling, thereby leading consumers to choose the latter over the former.

Cost

Eugene ascertains its cost model from the largest of its MSW and recycling collection providers, which is Sanipac. However, Sanipac's cost model, or at least the one with which it provides the city, is far less detailed and comprehensive than a comparable one in Portland. We will thus examine Portland's cost model to acquire the cost components of MSW and recycling, keeping in mind it is not identical to Eugene but at least illustrative of it.

The single largest direct cost of recycling—indirect costs being general and administrative costs—are recycling co-op payments, which is essentially what the city pays to a

recycling facility to take recycled materials. On a par with such a cost are the wages of route drivers and mechanics. Other costs include depreciation, maintenance and repair of vehicles; medical and other insurance, payroll taxes, fuel, and pension plan expenses. Similar cost compositions are evident in solid waste collection, where landfill disposal costs are substituted for recycling co-op payments. Indirect costs that serve both services include management and administrative salaries, professional fees, and office costs such as rent, telephone, supplies and postage. The yard debris and compost services that Eugene provides can be assumed to have similar cost composition.

One other important piece to note is that while this is gross cost, net cost is slightly lower due to revenue generated from recycled materials, a number equal to approximately 3% of total cost.

Thus the cost of recycling (and yard debris and compost) collection is reflected in the price of municipal solid waste to consumers, which, in Eugene, includes an 11% margin of profit for the firm. This implies a falsely negative producer surplus in the recycling market and a producer surplus that appears higher than it truly is. Further complicating the dynamic between the market for waste and recycling is the cross subsidization that takes place between residential consumers and commercial consumers, in which the price of residential waste is subsidized by the commercial waste price.

A. Classifying Valuation Methods:

The focus of Kaplan and Aadland's project was on the social benefits of recycling, as determined by contingent valuation method (CVM). CVM data are frequently used to estimate functional relationships between WTP responses and other variables normally affecting demand (Cameron & Huppert, 236). This approach seeks to uncover personal valuations that cannot be observed in a market. The following discussion presents some of the challenges of CVM and what was done to overcome them.

WTP can be measured using two distinct approaches: direct observation and indirect observation. Direct observation methods are those that involve observing people's actual choices and inferring conclusions from them. Indirect methods rely on inference based on related data to draw conclusions rather than the data itself, such as analyzing hedonic property values to determine valuation of proximity to a recreational area or natural attraction, such as a hiking trail.

We are most interested in the direct CVM, an approach that seeks to quantify values that cannot be discerned or observed in a market context. CVM is used to estimate dollar values for many goods that do not trade in markets, such as social benefits of environmental projects, existence of a species, air quality and the quantity of fish in a given coastal region. As with any measurement method, error will inevitably present itself in the form of bias. There are four types of bias that can affect the reliability of the CVM: 1. Strategic bias 2. Information bias 3. starting point bias 4. hypothetical bias (Tietenberg 39).

Strategic bias occurs when the respondent gives a false answer that deliberately aims to influence the outcome of the survey, such as claiming that one would pay \$10,000,000 to reduce

air pollution their city by 0.1%. Information bias typically occurs when respondents are asked to value characteristics which they have little or no experience with, such as asking a life-long resident of Nebraska what he values the water quality of a segment of the Willamette Rive in Oregon. Starting point bias occurs when the survey itself presents a particular range of values from which respondents select their answer that influences the results of the study in a particular fashion. For example, a survey that asks for people's valuations of the value of clean streets in their city and offers a range of answers between \$5 and \$100 may conclude different results than if the range was between, say, \$25 and \$250. This may be attributed to a "bounding" psychological effect implied by a particular range of possible answers that shapes the respondents' sense of what "acceptable" answers are. Hypothetical bias introduces itself because respondents are posed engineered, rather than actual questions and, knowing that they will not be held accountable to their answers, have the unlimited freedom to over- or understate their answers. This bias differs from strategic bias in that it deals with non-accountability and not an intention to affect results. Aadland and Kaplan's survey design carefully addressed these issues in the following manner:

Respondents were asked whether or not they would be willing to pay a dollar amount somewhere between \$1 and \$10 (initially), thereby reducing the effect of potential strategic bias due to the narrow range of possible answers. The range itself may appear to have caused starting point bias, yet given the nature of the question, the range of possible values is reasonable and places a judicious boundary on the range of answers. Previous studies have shown that WTP can be negative (i.e. people would need to be paid in order to participate), so this study bounded the WTP range at \$0 at the minimum. This constraint may bias results upwards because it does not offer respondents the option to express that they would need to *be* paid to utilize recycling

services in lieu of refuse (negative WTP). Information bias was controlled for by categorizing respondents according to whether their city offered recycling services or not. Hypothetical bias was taken into account by including a “cheap talk” statement in the study. Cheap talk is a statement read to respondents prior to asking what their WTP is. The statement asks respondents to keep in mind what their actual monthly budget is, that there are alternatives to curbside recycling services and that some people say they are willing to pay amounts different than the amounts they would actually pay when recycling became available in their community (Aadland & Caplan, Questionnaire, 22). They purposefully over-sampled households in communities with voluntary CRPs to allow for the detection of any hypothetical bias in the data (Aadland & Caplan 14).

The approach employed in the survey addresses the information bias by categorizing respondents by the type of institutional arrangements in their cities (No CRP, Mandatory CRP and Voluntary CRP), meaning that this form of bias was controlled for in the regression analysis.

IV. Data gathering

As discussed in the section above, the data were acquired by Washington State’s Survey Research Laboratory via telephone surveys for Aadland and Caplan’s paper entitled “Curbside Recycling: Waste Resource or Waste of Resources?” to determine individual’s WTP for recycling services in their community. In spite of the inherent complications associated with contingent valuation surveys, we believe that the double-bounded dichotomous choice method used provides reliable measures as a result of its intelligent management of biases.

WTP is determined by a wide variety of factors, ranging from age and gender, to political affiliation, to whether or not their neighbors recycle. Our regression analysis seeks to uncover the correlation between all relevant independent variables and the dependent variable (WTP).

V. Econometric Methodology

Given that the data were mostly categorical in nature (Yes/No) we were not able to use a standard OLS regression approach. Instead, we used a logit model that allowed us to interpret the regression results directly after applying a simple mathematic procedure to each β (coefficient). The procedure consisted of dividing each resulting coefficient by the negative coefficient of the “pay” variable in the regression (Cameron 1987 paper).

The following are the explanatory variables used in our model:

Income
Education
Gender
Age
Membership in Environmental Orgs.
Ethical Obligation
Monetary Benefit
Existence of Drop off Center
Existence of CRP
Usage of CRP
Received cheap Talk
Job Performance
Eugene

In attempting to ascertain whether Eugene residents are willing to pay significantly higher levels of recycling we begin by including Eugene as a dummy variable along with a level of WTP. Next we will include the demographic variables like income, age, gender and education to see if such a hypothesized increase from Eugene remains when taking such factors into account. When this holds up, which we hypothesize that it will, we will include the cheap talk variables to account for potential biases arising from the above-mentioned possibilities. If this

still remains we will include city characteristics like whether or not the city's surveyed have curbside and drop off recycling programs. We will introduce a slope dummy of Eugene and the cities that have CRPs so that we can see if Eugene residents have higher WTP than other residents who live in cities with the CRPs, thus controlling for the possibility that cities who do not have curbside have especially high WTP for services the lack. Next we will include a variable that includes job performance to see if it is the specific performance of Eugene's CRP that is behind its citizens higher WTP. If Eugene still does not turn insignificant we know it is not an especially well-run program that causes Eugene's higher WTP. We will also include a variable that indicates whether or not a city has a drop off recycling center to see if cities with centers have higher WTP for a CRP, the drop off center's alternative. We also introduce variables to the regression that represent environmentally inclined attitudes in Eugene. Such variables include whether or not citizens recycle because of ethical duties to the environment, whether or not citizens belong to environmental organizations and whether or not citizens participate in the city's curbside program. If the significance of the Eugene variable goes away here we allow for the possibility of multicollinearity between these variables and Eugene. Such multicollinearity may help to explain Eugene's higher WTP. Other variables may be interesting in explaining WTP. For instance whether or not citizens are motivated to recycle for monetary reasons and if so whether or not such motivation is stronger or weaker than an ethical obligation.

Some data were modified in form so that they could be marginally interpretable. For example, Aadland and Caplan's study categorized individuals by discrete levels of education (e.g.: high school diploma, undergraduate degree), not by their absolute years of schooling, which made interpreting the coefficient confusing. We generated new variables that represented each respondent's number of years of education and used it instead.

VI. Data analysis

Descriptive stats:

It is useful to compare a variety of stats from the sample taking note of their values for Eugene as compared to the rest of the sample. One important one is participation rate in a city's curbside recycling program, denoted as "b4b" in the survey.

		B4B		
		0	1	Total
eug	0	3,540	5,404	8,944
	1	68	380	448
Total		3,608	5,784	9,392

B4B Asked those people who live in cities with curbside recycling programs whether or not they utilize the program. As the table shows, 5,784 out of a total of 9,392 respondents (or 61.6%) use CRP service. In Eugene, this rises to 84.8%--a dramatic increase and an interesting point in terms of WTP for a recycling program. This seems to show that those who participate in their CRP programs are more likely to have higher WTP values.

Next we examine participation rates in environmental programs, or "envi" in the data set.

		ENVI		
		0	1	Total
	0	14,720	1,488	16,208
Eug	1	340	104	444
Total		15,060	1,592	16,652

Again, looking at those who say yes to a question asking whether or not they belong to an environmental organization differs strongly for Eugene and the rest of the sample. Such a question yields a participation rate of 9.6% for the entire sample and 23.4% for Eugene. This remarkable difference may also help account for the predicted higher WTP values for Eugene.

Next we look at the percentage of respondents who said they felt “an ethical duty to recycle to help the environment.” Again, we will look at such percentages both across the sample and within respondents who were from Eugene. We expect, in keeping with our hypothesis, that Eugene will have a higher percentage of such respondents.

		OP1		
Eug	0	1	Total	
0	1,920	14,468	16,388	
1	24	428	452	
Total	1,944	14,896	16,840	

Here, the total sample revealed that 88.5% of respondents said they felt an ethical duty to recycle. Again the number for Eugonians is higher, 94.7%

It is also important to compare the performance of curbside recycling programs across the board. All respondents who said they used the city’s curbside recycling program were asked to rate its performance: either excellent, good, fair or poor. Again, we can compare the responses of Eugene residents to other cities’ residents. Here we do not expect to explain environmental tendencies of respondents but rather attempt to explain why the hypothesis may be true that people in Eugene are willing to pay higher amounts for recycling.

Here are the results with 1=excellent:

		JOB			
Eug	1	2	3	4	Total
0	2,452	2,184	596	68	5,300
1	192	156	24	4	376
Total	2,644	2,340	620	72	5,676

Expressed in percentage terms, 46.6% of the total population said excellent, 41.2% said good, 10.9% said fair, and 1.3% said poor. Compare this to 51.1% of Eugene residents who said excellent, 41.5% who said good, 6.3% who said fair, and 1.1% who said poor. Two implications can be drawn from this: The first is that both samples are fairly close together with both strongly

skewed to high ratings. The second is that because both distributions are similar, it is most likely not the performance of the CRP that explains why Eugene residents have higher WTP and is then due to other factors.

On education, we immediately noticed a marked difference from the national average in terms of the level of education of the respondents. The following is Census 2000 data:

Educational Attainment	Number of ppl	% of population
1. Less than 9th grade	14,835,153	7%
2. 9th to 12th grade, no diploma	27,715,099	13%
3. High school graduate (includes equivalency)	59,906,752	29%
4. Some college, no degree	47,636,493	23%
5. Associates degree	12,608,526	6%
6. Bachelor's degree	30,281,901	14%
7. Graduate or professional degree	16,295,225	8%
Total:	209,279,149	100%

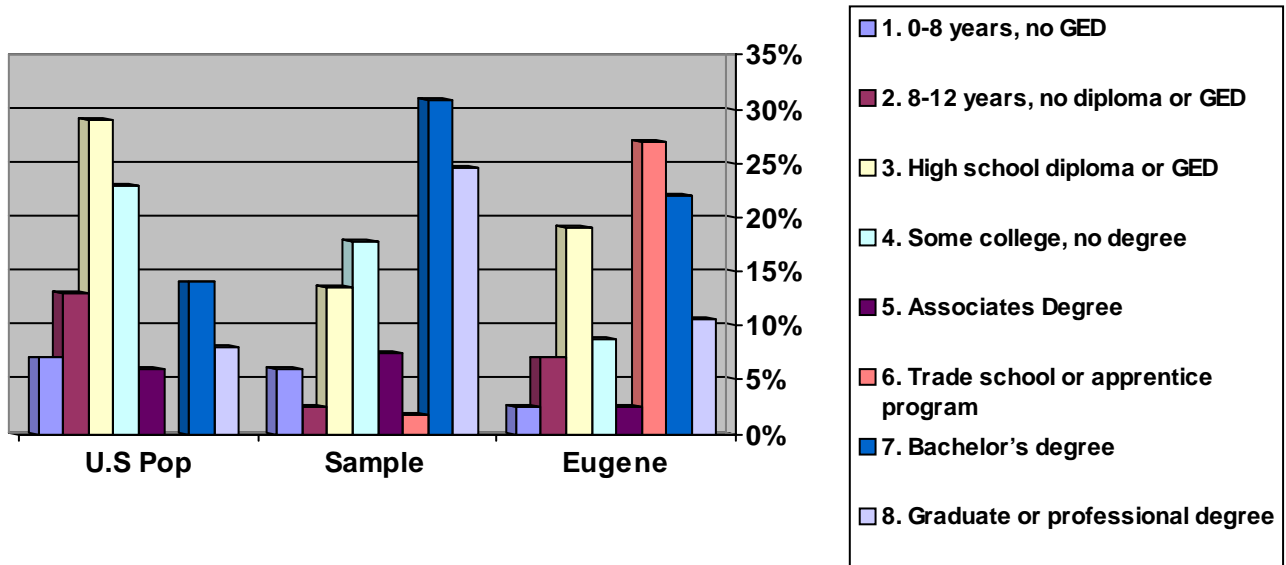
Sample data:

Educational attainment	Number of ppl	% of population
1. 0-8 years, no GED	24	0.6
2. 8-12 years, no diploma or GED	100	2.5
3. High school diploma or GED	542	13.5
4. Some college, no degree	711	17.7
5. Associates Degree	303	7.5
6. Trade school or apprentice program	72	1.8
7. Bachelor's degree	1,242	30.9
8. Graduate or professional degree	988	24.6
Total:	4,021	

The discrepancy between the sample and the general U.S. population is probably due to a higher willingness to participate of educated individuals. Bringing the focus to the city of Eugene, we compare statistics:

Educational attainment	Number of ppl	% of Eugene population
1. 0-8 years, no GED	3	2.5
2. 8-12 years, no diploma or GED	8	7
3. High school diploma or GED	22	19
4. Some college, no degree	10	8.8
5. Associates Degree	3	2.5
6. Trade school or apprentice program	30	27

7. Bachelor's degree	25	22
8. Graduate or professional degree	12	10.6
Total:	113	



Eugene's sample resembles the United State's population with respect to education more closely than the complete sample. This lends credibility to the claim that the reason for Eugene's marked difference in WTP does not stem from the higher education levels. As will be seen in the forthcoming section, the increase in Eugene's WTP is due to the social and political orientation of its population, as revealed in membership in environmental organizations and higher sense of "ethical obligation" to recycle.

VII. Reporting econometric analysis

We will begin this section with an elementary regression testing Eugene's WTP as compared to the rest of the sample.

1. y	Real coef.	Coef.	Std. Err.	P>z
pay		-0.305	0.005	0
Eugene	0.926	0.283	0.123	0.022
cons		2.025	0.032	0

n=16,712

This initial regression demonstrates that citizens of Eugene are willing to pay, on average, \$0.93 more than other cities for recycling services. Consider this analogous to an upward shift in a demand curve. The following series of regressions will demonstrate *where* and *why* there is a marked increase in WTP in Eugene by substituting included variables in the regression and discuss their effects on Eugene's WTP.

This regression includes key demographic variables income, age, gender and education:

2. y	Real coef.	Coef.	Std. Err.	P>z
pay		-0.32031	0.005733	0
Eugene	0.989	0.316	0.133	0.018
income	0.0058	0.001	0.0009	0.09
age	-0.065	-0.020	0.001	0
gender	-1.013	-0.324	0.042	0
education	0.329	0.105	0.010	0
cons		1.572	0.155	0

n=3,729

Results show that for each year of education a person is willing to pay an additional \$0.33 for recycling services in their community. Men are willing to pay about \$1 less than women, and for each additional year someone ages their WTP declines by about 7 cents. The Eugene coefficient remains positive and statistically significant in the presence of demographic variables. Perhaps the increase was due to hypothetical bias in the study? The following regression controls for such bias by including cheap talk variables (notlk=respondent received no cheap talk, longtlk=respondent received long version of cheap talk).

3. y	"real coef."	Coef.	Std. Err.	P>z
pay		-0.320	0.006	0
Eugene	0.951	0.305	0.134	0.023

Income	0.005	0.001	0.001	0.094
Age	-0.069	-0.020	0.001	0
gender	-1.019	-0.327	0.043	0
education	0.329	0.105	0.011	0
notlk	-0.455	-0.146	0.051	0.005
longtlk	0.370	0.119	0.051	0.02
_cons	4.933	1.579	0.158	0

n=3,729

Again, Eugene maintains its significance and is relatively unchanged. This result is counter-intuitive, for we hypothesized was that someone who receives a cheap talk is more likely to temper their response and give a *lower* WTP than they would have otherwise. The results demonstrate that the opposite is true. Receiving a cheap talk pushed WTP upwards and not receiving one influences it downwards. What is surprising about this particular result is that this question asks the respondent to place themselves in their own financial reality and answer the question accordingly. We expected that someone answering a question purely hypothetically would be unencumbered by their particular budget constraint and therefore likely to have a higher WTP. Nonetheless, we see that the Eugene coefficient remains significant and remains essentially unchanged after the demographic variables as well as the variables controlling for hypothetical bias are added. In fact, all other variables remain fairly static. This leads us to believe that other qualities/variables are responsible for the difference in WTP.

4.	y	"real coef."	Coef.	Std. Err.	P>z
	pay		-0.330	0.006	0
	Eugene	0.533	0.176	0.138	0.202
	income	0.007	0.002	0.001	0.014
	age	-0.067	-0.022	0.001	0
	gender	-0.862	-0.285	0.044	0
	education	0.278	0.092	0.011	0
	envi	1.984	0.655	0.083	0
	op1	3.391	1.120	0.064	0
	_cons		0.812	0.169	0

n=14,651

The story now begins to unfold. Eugene's coefficient changes drastically and becomes statistically insignificant with the inclusion of a subset of variables representing environmental sentiment in the regression, *envi* (=whether or not the respondent is a member of an environmental organization) and *op1* (=whether or not the respondent feels an "ethical obligation" to recycle). In other words, Eugene loses its significance due to multicollinearity.

That is to say that the variation found Eugene's increased WTP is attributed to its populations' measurable inclination towards environmental stewardship as revealed by the included variables. Both variables have remarkable positive influences on WTP, about \$2.00 and \$3.40 respectively. Restated, a respondent who is a member of an environmental organization is willing to pay \$2.00 more than someone who is not and someone who feels that they have an ethical obligation to recycle is willing to pay a whopping \$3.40 more than someone who does not feel an ethical obligation.

The following regression tells a concise story about individuals who respond in the positive to whether or not they are motivated to recycle to save money (*op2*).

5. y	"real coef."	Coef.	Std. Err.	P>z	
pay			-0.330	0.006	0
Eugene	0.600	0.198	0.138	0.151	
income	0.006	0.002	0.001	0.054	
age	-0.071	-0.024	0.001	0	
gende	-0.846	-0.280	0.044	0	
education	0.255	0.084	0.011	0	
envi	1.939	0.642	0.083	0	
op1	3.567	1.180	0.065	0	
op2	-0.767	-0.253	0.045	0	
_cons		1.082	0.176	0	

n=3,646

Those who answered affirmatively to this question are willing to pay approximately \$0.77 less for recycling services than those who answered in the negative.

The next scenario takes into account whether or not cities have recycling programs in place and compares them with cities that do not.

6. y	"real coef."	Coef.	Std. Err.	P>z
pay		-0.330	0.006	0
Eug	0.765	0.252	0.140	0.07
income	0.010	0.003	0.001	0.001
age	-0.067	-0.022	0.001	0
gen	-0.899	-0.297	0.045	0
education	0.275	0.091	0.011	0
envi	2.063	0.681	0.084	0
op1	3.493	1.153	0.068	0
aa1	-0.577	-0.190	0.046	0
_cons	2.579	0.851	0.174	0

n=3,465

Perhaps not surprisingly, people who live in cities that offer curbside a recycling program (CRP) are willing to pay \$0.58 less than those who do not have one. This may be due to the added household labor associated with sorting and placing recyclables for pick up. We speculate that a introducing a commingled, otherwise known as “single stream,” recycling program would increase individuals’ WTP due to the transfer of opportunity cost from households to the firms. The effect is likely to be most dramatic as a switch between programs takes place and as consumers can perceive the contrast between the former system that required extensive opportunity cost and the new one that requires substantially less. All experience is by contrast.

Next we analyze the effect of respondents’ subjective appraisal of their CRP, captured by “job.” This variable is the quantified measure of people’s rating of the CRP in their cities.

7. y	"real coef."	Coef.	Std. Err.	P>z
pay		-0.318	0.010	0
Eug	0.462	0.147	0.155	0.343
income	0.024	0.008	0.002	0
age	0.356	0.113	0.020	0
gen	-0.042	-0.014	0.003	0
education	-0.919	-0.292	0.078	0
job	-0.555	-0.178	0.054	0.001
_cons	4.517	1.438	0.323	0

n=4,842

To interpret this coefficient, it must be noted that the question asked respondents to rate their program on a continuous scale, with 1 being “excellent,” 2 being “good,” 3 being “fair,” and 4 being “poor.” For each movement away from 1, respondents were willing to pay \$0.60 less. Their response is a judgment on the quality of the service they receive, so it is fitting that they would pay less the worse the service was.

Next, we wish to evaluate the effect of participation in an existing recycling program on WTP. We accomplish this by adding “b4b,” the variable representing whether or not the respondent uses their curbside recycling program.

8. y	"real coef."	Coef.	Std. Err.	P>z
pay		-0.340	0.008	0
Eugene	0.078	0.026	0.142	0.853
income	0.007	0.003	0.001	0.068
age	-0.059	-0.020	0.002	0
gender	-0.658	-0.223	0.060	0
education	0.244	0.083	0.015	0
envi	2.121	0.720	0.107	0
op1	2.590	0.880	0.102	0
b4b	2.556	0.868	0.063	0
_cons	1.441	0.489	0.238	0.04

n=2,013

In contrast to the previous regression, this variable increases WTP drastically, by \$2.56. This result is consistent with our preliminary hypothesis, that those who choose to *use* their recycling programs are likely to also *value* it more. Notice the reduced sample size for this regression. This is because only a portion of the total sample has recycling programs, therefore a large section of the sample was dropped from the regression.

The following regression asks whether or not the respondent has a drop off center for recycling in their community (aa2).

9. y	"real coef."	Coef.	Std. Err.	P>z
pay		-0.330	0.006	0
Eug	0.564	0.186	0.139	0.182
income	0.008	0.003	0.001	0.014
age	-0.0676	-0.022	0.001	0
gen	-0.935	-0.309	0.047	0
education	0.286	0.0944	0.011	0
envi	1.900	0.627	0.085	0
op1	3.108	1.026	0.070	0
aa2	0.404	0.134	0.078	0.088
cons	2.240	0.735	0.192	0

n=3,263

We find the result significant at the 10% level and with a positive coefficient. Those who have a drop off facility in their community are willing to pay \$0.40 more for curbside recycling. Why is it that those who have a program are willing to pay *less* for it than those who do not? We believe that this is due to the fact that those who have drop off centers would prefer not to use them and have curbside instead. Inspection of the following table shows that 87% of those who do not have CRP do have a drop off facility. The above regression may be demonstrating the lack of enthusiasm those respondents have towards driving their recyclables to a drop off center and their desire to have the materials picked up outside their homes instead.

	AA1	AA2	Total
0	820	5,324	6,144
1	588	7,692	8,280
Total	1,408	13,016	14,424

Consumer surplus for Eugene:

Consumer surplus can be derived from a downward sloping demand curve. This includes an intercept of \$5.00, which is the approximate WTP when dividing the constant by Bpay. From this we find the point at which the demand curve intersects the negative price of -\$5.00. This is the rebate that Eugene gives its consumers of MSW services for recycling. It also serves as a

supply curve, even though it is negative, because it is constant and producers service at such a price regardless of the quantity. Therefore at whatever point the demand curve hits such a cost curve, becomes the quantity. Consumer surplus is derived from multiplying this quantity by \$10.00 (WTP minus price) and dividing by two. Again we should remember that this is a number that is in fact greater than social welfare for the recycling industry because its rebate is in essence subsidized by the MSW industry.

VIII. Summary and conclusion

It is clear that Eugene residents have a significantly higher WTP than non-Eugene residents. This significance goes away when we include variables that describe citizens from any city's possible attitude toward recycling and the environment. From this we can conclude that such attitudes evoke higher WTP for recycling and that Eugene residents generally carry such attitudes.

We should remember that possibilities for higher WTP may arise if more cities carried a higher (cost based) approaches to the pricing of waste. We should also remember that due to subsidization price does not accurately reflect WTP, especially in Eugene. Additionally, the cross-subsidization that occurs from the commercial rates of refuse to residential do not accurately affect market conditions and may generate higher waste and less recycling then would occur otherwise.

Our study does not take such possibilities into account and so, in conducting a cost-benefit analysis we can only take into account the ostensible recycling market and not necessarily the actual market.

Additionally, in regards to the criticism that recycling is too costly, cities with higher WTP will in a sense be able to absorb higher levels of recycling because of higher social benefit gains. Their demand curve will remain above the cost curve due to, what boils down to an upward shift in demand. This upward shift is, as our regressions demonstrated, is due to a “Eugene effect.” Really this effect is due to the makeup of Eugene’s residents, namely that they are environmentally inclined.

Again, we should remember any consumer surplus is in fact greater than social welfare, and thus not to get overly excited, for the recycling industry in Eugene because its rebate is in essence subsidized by the MSW industry. Here producer surplus is negative because cost is well above price.

Policy implications:

In accordance with the recommendations made by Aadland and Caplan, each municipality ought to weigh the benefits and costs within its own jurisdiction rather than rely on national data or averages thereof. Decisions at the local level are best made with respect to the individuals affected by the decision. Although it is useful to know how other municipalities conduct their MSW and recycling systems and what is charged for the services, it is irrelevant in this context. To make sound policy recommendations we must only take into consideration what is germane and exclude that which is not. Therefore, the following recommendations will be based on the detailed survey data for the city of Eugene gathered by Caplan and Aadland and Census 2000 data for the city of Eugene.

What would we expect a Eugene resident to pay for recycling services? Using regression number 7 from the previous section and data from Census 2000, we determined that the average Eugene resident is willing to pay \$8.25 per month for recycling services. This result is based on the following demographic characteristics: The “average” person in Eugene is 36 years old, has 14 years of education (i.e. two years of post-secondary education) and earns \$48,576.72 per year. We arbitrarily chose to use a female’s WTP, which raises every WTP value by \$1.02.

As shown in the regression, WTP is affected by whether or not a respondent received a cheap talk. To account for potential biases, we used the “short talk” variable in the regression since it represents a compromise between the extremes.

Given that there is a range of incomes, the following table represents the likelihood of WTP across income levels using a regression that excludes the education variable (in order to avoid multi-collinearity):

Income	WTP
\$15,000	\$8.22
\$30,000	\$8.50
\$42,500	\$8.74
\$48,576.72	\$8.85
\$62,500	\$9.12
\$87,500	\$9.59
\$125,000	\$10.31
\$175,000	\$11.26
\$250,000	\$12.68

The following is a table of useful statistics regarding the city of Eugene:

What proportion of Eugene residents...

• use the curbside recycling program?	85%
• feel an ethical obligation to recycle?	95%
• recycle primarily to save money?	58%
• are more motivated to by environmental concern than money to recycle?	69%
• are members of environmental organizations?	23%
• rate the recycling program as “excellent”?	51%
• rate the recycling program as “good”?	42%
• rate the recycling program as “fair”?	6%
• rate the recycling program as “poor”?	2%

Eugene residents participate in the curbside recycling program at a remarkably high rate, are more driven by environmental motives than money to recycle, and are about 2.5 times as likely to be members of environmental organizations than citizens of other Western cities in the United States. Additionally, 93% rate the recycling program as “excellent” or “good.” Take into consideration that these figures reflect people’s responses *prior* to the implementation of the nascent comingled recycling program. We expect if the survey was re-conducted, the participation rate, as well as people’s subjective appraisal of the program, would be even higher.

We advise city managers to consider that Eugene residents have demonstrated that they are highly motivated by “altruistic” factors, are politically active and pleased with the current

recycling program when formulating future programs or instituting changes to those that are already in place. The results of this study allow us to place an estimated value on the *city's* aggregate WTP for recycling services. This figure is determined by multiplying the average WTP by the number of households in the city: $\$8.25 \times 57,996 = \$478,467$. Underlying this result is the assumption that a WTP for each household is represented by the “average” Eugenic identified in the regression. However, aggregate benefit is definitely much higher due to the fact that each household is typically composed of more than one person. Therefore each household is underrepresented in this figure because it receives benefits in addition to the average person used in the calculation. These are the key benefit components of a cost-benefit analysis.

It should be noted that not all benefits are captured in the above value. Other benefits include revenues from the sale of recycled materials and decreased levels of groundwater damage, methane emissions and odor due to potential decreases in waste generation. WTP is a hugely important piece of the benefit puzzle and the above value should not be overlooked.

The study concludes that an average Eugene resident has a monthly WTP of \$8.25 for recycling services over and above their garbage bill. This fact is useful when considering rate changes in the future because, currently, residents are given a rebate for participating in the recycling program. Perhaps the high participation rate was due to the rebate? We believe that this is probably not the case given that 95% of Eugene respondents feel an ethical obligation to recycle, only 31% are more motivated by money than environmental concern and 93% rate the service at least as “good.” Would tampering with the rebate decrease participation? We believe that participation would not suffer greatly either, as corroborated by the preceding statistics. The city of Eugene possesses leeway in its rate schedule for recycling as revealed by citizens’ positive WTP for services and strong tendency for environmentally oriented activities.

Works Cited

- Aadland, David. And Arthur J. Caplan. Curbside Recycling: Waste Resource or Waste of Resources?
- Cameron, Trudy Anne. 1987. A New Paradigm for Valuing Non-Market Goods Using Referendum Data: Maximum Likelihood Estimation by Censored Logistic Regression. *Journal of Environmental Economics and Management*. Feb.
- Census 2000 Summary File. "PCT25 Sex by Age by Educational Attainment for the Population 18 Years and over." Online. <http://factfinder.census.gov/servlet/DTable?_bm=y&-geo_id=01000US&-ds_name=DEC_2000_SF3_U&-lang=en&-mt_name=DEC_2000_SF3_U_PCT025&-sse=on>
- City of Eugene. Hilton Frankopf & Hobson LLC. Survey of Largest 20 Oregon Cities' Solid Waste and Recycling System and Rates. 2001.
- Palmer, Karen, Hilary Sigman and Margaret Walls. 1997. The Cost of Reducing Municipal Solid Waste. *Journal of Environmental Economics and Management*, June.
- Porter, Richard. The Economics of Waste. Washington D.C.: Resources for the Future. 2002.
- Nicholson, Walter. Microeconomic Theory: Basic Principles and Extensions. U.S.A.: Thomson Learning. 2002.
- Pindyck, Robert S. and Daniel L. Rubinfeld. Microeconomics Upper Saddle River, NJ: Prentice Hall. 2001.
- Tietenberg, Tom. Environmental and Natural Resource Economics. U.S.A.: Addison Wesley Longman. 2000.

Appendix

Theory of Natural Monopolies

“A natural monopoly is a firm that can produce the entire output of the market at a cost that is lower than what it would be if there were several firms. If a firm is a natural monopoly, it is more efficient to let it serve the entire market than have several firms compete (Pindyk & Rubinfeld, 350).” Consistent with economic theory, MSW services are provided most efficiently by a single firm, rather than many. This is due to the increased efficiency gained by a single truck sweeping uniformly through a street instead of a number of trucks picking up *their* respective customers’ SMW in the same area. Variable costs, the majority of which is labor and attached costs, constitute the largest portion of the total cost for MSW firms (NYCIBO, Portland data). Therefore, using labor most efficiently yields the most significant efficiency gains.

In spite of the efficiency gained by having a natural monopoly providing services, there is the risk of consumers paying a higher rate for the service due to lack of competition in the market and the subsequent freedom the monopolistic firm enjoys in price setting capabilities.

Regulation of natural monopolies

In order to ensure a balance between firm and consumer surplus, a regulatory guideline must be put in place. One such guideline is called “rate-of-return” regulation. “Rate-of-return regulation is based on the rate of return that it earns on its capital. The regulatory agency (in our analysis the agency is the city or local government) determines an allowed price, so that this rate of return is in some sense ‘competitive’ or ‘fair’ (Pindyk & Rubinfeld, 351).” The agency sets a maximum the firm will earn. This price is price based on the (expected) rate of return. This is precisely what is taking place within the city of Eugene, although not necessarily for the same economic reasons. The city awards *each* firm the same rate-of-return, irrespective of whether it

is the natural monopoly or not. What seems to be taking place is the process by which a particular firm is *becoming* the natural monopoly in the Eugene SMW market.

Recycling and Solid Waste Study:

How does Eugene, Oregon compare with other cities in the United States in terms of willingness to pay for recycling services?

Abstract: In this paper we aim to determine how the city of Eugene, Oregon compares to other cities in terms of its citizens' willingness-to-pay (WTP) for recycling service. Also, we will determine what the expected WTP for Eugene residents and use that result to make policy recommendations. We use WTP as an indication of a city's relative valuation of recycling services in their community. We will use WTP as the measure for consumer benefit (demand).

Approved: _____

Prof. Bill Harbaugh

Date: _____