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Policy Watch
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This feature contains short articles on topics that are currently on the agendas of policymakers, thus illustrating the role of economic analysis in illuminating current debates. Suggestions for future columns can be sent to C. Eugene Steuerle, c/o *Journal of Economic Perspectives,* The Urban Institute, 2100 M Street NW, Washington, D.C. 20037.

Introduction

Most households in the United States engaged in little or no recycling 20 years ago. Household waste was deposited in the municipal dump, and any recycling was organized by charitable organizations looking to earn revenue from sales of old newspapers and aluminum cans. Today, nearly 8,875 municipalities in the United States, where roughly 48 percent of the population lives, have implemented curbside recycling programs. As a direct result, the portion of all solid waste that is recycled has increased from just over 10 percent in 1990 to nearly 30 percent in 2000 (Kaufman, Goldstein, Millrath and Themelis, 2004). To encourage participation in recycling, roughly 4,000 municipalities require households to purchase a special can, bag, tag or sticker for each unit of garbage presented for collection (Miranda and Byrum, 1999).

The expansion of recycling grew from two roots. First, Subtitle D of the Resource Conservation and Recovery Act (RCRA) of 1976 provided federal guidelines for the construction, operation and closure of landfills. Old municipal dumps were soon out of compliance with the new laws and were forced to close. Public worries over a "crisis" lack of landfill space were fanned by incidents like the 1987

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voyage of the barge Mobro, loaded with New York City garbage, which paraded up and down the Atlantic seaboard unable to a locate a suitable disposal facility. Actually, throughout the period between 1988 and 1997, the *number* of landfills operating in the United States decreased from over 8,000 to less than 3,000, even though landfill *capacity* increased from nine years of available storage space to over 20 years (Kinnaman and Fullerton, 2000b). Nonetheless, many states embraced recycling as a method to reduce the need for landfill storage and passed new legislation to encourage or require municipalities to offer recycling services to their households. In addition, there was general heightening of public consciousness about the salience of environmental issues in the 1970s and into the 1980s, and reducing household garbage through recycling was part of that movement.

In response to the new state legislation and changing public attitudes, many municipal governments initiated curbside recycling programs. Several years of experience with curbside recycling and unit-based pricing have given economists ample data to study their effects, costs and benefits. This article summarizes these findings, which suggest that the benefits of recycling accrue primarily as utility gained by recycling households, while efficiency gains from unit-based pricing over the last two decades have been quite small. This evidence also suggests a fundamental change in this country's approach to regulating solid waste quantities. Specifically, state mandates that require municipalities to implement unit-based pricing programs and especially curbside recycling programs could be usefully replaced by disposal taxes levied at the landfill.

Residential Curbside Recycling

Residential curbside recycling has increased over the past two decades despite the fact that these programs are financially costly. The costs to the municipality to collect, process and transport recyclable materials exceed by an average of roughly $3 per household per month the budgetary benefits of reduced disposal fees and revenue from the sale of recycling materials (Kinnaman, 2000; Aadlan and Caplan, 2005). On a per-ton basis, recycling is roughly twice as costly as landfill disposal. The costly nature of recycling is easily confirmed by the budget records of many cities and municipalities, even those that ignore the opportunity cost of allocating municipally owned resources such as warehouses and administrative staff to the recycling program. Why, then, do many state governments require curbside recycling?

Recycling Reduces Reliance on Solid Waste Landfills

The external costs of solid waste disposal in remote landfills are not internalized by garbage-producing municipalities. The external costs of landfills include the odor, visibility and general disamenities to surrounding neighborhoods, which could reduce property values. The consensus reached by 13 hedonic pricing studies is that a home located within one mile of a landfill is worth 5 to 10 percent less than a comparable home away from a landfill (Defra, 2003). This reduction in property

values occurs largely during the initial citing and construction of the landfill. Subsequent owners of these properties internalize the costs by paying less for the property. Using assumptions about the number of homes located within close proximity to the landfill, the value of those homes, the quantity of waste deposited per year at the landfill, and the discount rate, Defra (2004) estimates the disamenity costs to range between $3.05 and $4.39 per compacted ton (virtually all waste entering landfills is compacted by collection trucks) disposed over the lifetime of the landfill.

The external costs of landfill disposal may also include the threat to area groundwater resulting from a possible breach in the lining along the base of the landfill. However, federal regulations require that new landfills are designed to minimize the likelihood of such breaches; landfills are required to collect and treat what leaches out of the landfill and to monitor the groundwater for decades after the landfill closes; and landfills are legally responsible for all damages done by leaking. Thus, the landfill largely internalizes the costs of a possible breach and charges higher disposal fees ("tipping fees") as a result.

Landfills emit two greenhouse gasses—carbon dioxide and methane—during the natural decomposition of the solid waste. This component of external costs can vary for two reasons. First, some landfills accept only construction and demolition waste, which do not decompose as rapidly as household waste. Second, some landfills capture and burn methane for the generation of electricity, which is a relatively carbon-free form of energy that displaces the use of coal, oil and natural gas. Davies and Doble (2004) estimate that the external marginal cost attributable to greenhouse emissions is $3.27 per compacted ton of garbage disposed for landfills without energy recovery and $2.22 per compacted ton for landfills with energy recovery. Additional recycling may not reduce these external costs if the papers, plastics and metals that are recycled would not have contributed much to greenhouse gas emissions if they had decomposed in a landfill.

The remaining external cost of garbage disposal involves the transportation of solid waste to the landfill. Transportation of waste could cause congestion, air pollution and the increased probability of road accidents. Davies and Doble (2004) estimate these costs to be $0.51 per compacted ton for urban landfills and $1.69 per compacted ton for rural landfills. These external costs are not necessarily reduced by additional recycling, since recyclable materials must also be transported.

Based upon the above estimates, the external costs of solid waste transportation and disposal total between $5.38 and $8.76 per compacted ton. The landfill internalizes some of these external costs by paying per-ton "host fees" to neighboring townships and county governments for original permission to site the landfill. Presumably these host agreements are negotiated to make neighbors no worse off with the landfill and payment than without them (Jenkins, Maguire and Morgan, 2004). As an example, 26 private landfills in Pennsylvania pay local governments an average per-ton host fee of $4.05 per ton. Thus, this portion of the external costs of landfills is internalized by garbage generators. The remaining portion of the external costs of legal garbage disposal amounts to between $1.33 and $4.71 per

compacted ton in Pennsylvania. Additional recycling may reduce these external costs, but at a budgetary cost of $40 to $50 per ton (SWANA, 1995).

Recycling Preserves Natural Resources

The provision of recycled material reduces the demand for natural resources such as virgin timber and raw minerals. Assuming that markets for recycled material are sufficiently competitive, the marginal benefit of preserving natural resources through recycling is equal to the corresponding market price for each recyclable material and is therefore internalized by municipal recycling programs selling recyclable materials. Prices for recycled glass, various recycled papers and cardboards, and the various forms of recycled plastics have historically been near zero.[1] Fn1 Prices for aluminum and bi-metal cans are higher, but the quantity of these materials recycled by households is rather small. Judging by the price for recycled materials, the natural resource benefit of recycling is not particularly substantial. Any external costs created by natural resource extraction or processing that are not reflected in the price of these materials are not internalized by recyclers. Prices of recycled materials would need to double or triple from current levels to make the net benefits of recycling positive (Kinnaman, 2000).

Recycling Provides Utility to Participating Households

Recycling is something parents and children feel good about, and for this reason households may be willing to pay for recycling opportunities. An expanding literature employing the contingent valuation method, which uses surveys to estimate valuations, finds that households are willing to pay an average of $5.61 per month for recycling services (Jakus, Tiller and Park, 1996; Lake, Bateman and Partiff, 1996; Tiller, Jakus and Park, 1997; Kinnaman, 2000; Aadlan and Caplan, 2005).[2] Fn2 Unlike the sources of external benefits discussed above, these benefits to households exceed the $3 per household average cost of operating curbside recycling programs in some (but not all) municipalities.

This utility benefit to households can also be deduced by the appearance of private firms offering to collect household recyclable materials where municipal collection services are unavailable. In the 1980s and early 1990s, firms with names such as Paper Chase and Trash Rehash (both of which operated in Virginia), shared the market for collecting household recyclables before new municipal recycling programs offering free collection to households brought the private industry to an end. Residential customers were paying Paper Chase $12 per month in the early 1990s for weekly pickup of recyclable materials.

[1] I obtained the historical data on prices of recycled material from the Bureau of Labor Statistics.

[2] The contingent valuation method utilizes surveys that ask households to respond hypothetically to structured questions designed to elicit a monetary value for a household's willingness to pay for an environmental good such as a curbside recycling program. The most reliable studies first describe the aspects of the environmental good before asking directly, "Would you be willing to pay $X for this environmental good?" where X varies randomly across responders. A follow-up question increases or decreases the value of X depending upon the initial response. The *Journal of Economic Perspectives* devoted a symposium to the practice and controversies of contingent valuation in the Fall 1994 issue.

The utility benefit to households is also reflected by the many municipal recycling programs offering households the collection of recyclable materials for an added fee. Rates of voluntary participation in these recycling programs are substantial, even though the programs are costly to participating households (Aadlan and Caplan, 2005).

Lessons for Policy

T1 Table 1 summarizes existing estimates of the operating costs and utility benefits to households of curbside recycling programs. Note that the operating costs, even after subtracting saved disposal fees and revenues from the sale of recyclable materials, are universally positive. These costs vary between $0.86 per households per month in Lewisburg, Pennsylvania, and $5.10 in Palo Alto, California. The source of this variation includes the age of the program, the frequency of collection, the number and types of materials collected, the use of city employees or contracted private employees, the population density and the local costs of labor and fuel (Carrol, 1995; Bohm, Folz and Podolsky, 1999). Budgetary benefits such as saved disposal costs and revenue from the sales of materials also vary across the country, due to varying land prices and proximity to manufacturing centers. Disposal costs and prices for recycled materials are typically higher in the northeast than in other regions of the country.

Utility benefits to participating households also vary across municipalities, due to differences in tastes for the environment and the opportunity costs of employing household resources to recycling. Contingent valuation surveys suggest the active-use benefits to households vary between $7.57 per household per month in Tempe, Arizona, to as low as $4.06 in Inglewood, California. Clearly the net benefits of providing a curbside recycling program (the benefits to participating households minus the operating costs) are not positive for all communities. Thus, curbside recycling may not be beneficial in all municipalities.

But 22 states require all of their municipalities to establish curbside recycling
T2 programs, as listed in Table 2. For example, Act 101 passed in 1988 in Pennsylvania requires *all* municipalities with populations greater than 5,000 to implement curbside recycling. The number of recycling programs increased from 141 in 1988 to 709 in 1992. Another 22 states do not mandate curbside recycling, but require all of their municipalities to meet a recycling target. Some states utilize both measures. Given the heterogeneity in net benefits across municipalities, these state mandates may be welfare subtracting.

The False Promise of a Curbside Garbage Tax

When economists like Smith (1972) and Wertz (1976) began to study the market for solid waste, most municipalities financed solid waste collection services either with local property taxes or with fixed monthly or quarterly fees. Under these finance schemes, the cost of contributing one additional bag of garbage to the household is zero, which suggests households will generate more waste than is

Table 1
The Operating Costs and Utility Benefits of Recycling

Author	*Municipality*	*Monthly per Household Program Costs*	*Monthly per Household Utility Benefit*
SWANA (1995)	Five U.S. communities	$2.00	
Jakus, Tiller and Park (1996)	Nashville, TN		$5.78
Lake, Bateman and Partiff (1996)	United Kingdom		$4.50
Tiller, Jakus and Park (1997)	Nashville, TN		$4.05 (non-recyclers)
Tiller, Jakus and Park (1997)	Nashville, TN		$11.74 (recyclers)
Kinnaman (2000)	Lewisburg, PA	$0.86	$7.16
Aadlan and Caplan (2005)	Tempe, AZ	$1.62	$7.57
	Longmont, CO	$3.03	$7.21
	Orem, UT	$2.78	$5.75
	Wichita, KS		$5.16
	Fargo, ND	$2.68	$4.86
	Abilene, TX		$4.97
	Palo Alto, CA	$5.10	$5.03
	Olathe, KS	$3.58	$4.06
	Peoria, AZ		$4.81
	Escondido, CA	$3.16	$4.58
	Inglewood, CA		$4.06
	Newport Beach, CA	$3.42	$4.09
	Portland, OR	$2.89	
	Seattle, WA	$1.71	

socially desirable in a world where landfill disposal generates social costs. This inefficiency could be corrected with a direct tax on household garbage. Households paying the appropriately set unit-based charge internalize all social marginal costs of their garbage production. In response to this fee, households could reduce the amount of garbage they generate or divert some materials for recycling. Once a municipality has established unit-based pricing, no other recycling mandates are necessary. For these reasons, Repetto, Dower, Jenkins and Geoghegan. (1992), Miranda, Everett, Blume and Roy (1994) and Porter (1992) advocate a broader role for unit-based pricing programs.[3] Fn3

Municipalities operate three types of curbside pricing programs in this country. The first type, often called the bag/tag program, requires households to either purchase specific garbage bags, or purchase stickers or tags to affix on each of their

[3] Setting the appropriate fee for garbage collection can be tricky when there are both fixed and marginal costs of garbage collection. A curbside price of zero would have low garbage generators partly subsidizing the costs of high garbage generators. This notion may have motivated the implementation of some unit-based pricing programs. But a curbside price set equal to the average total cost of collection would have high garbage generators partly subsidizing the fixed costs of low garbage generators. For example, if the time that a truck idles outside a one-can household and a two-can household is the same, and the fees are set to cover the total cost of garbage collection, then the two-can household paying twice that of the one-can household has subsidized a portion of the collection costs of the one-can household. The municipality could employ a two-part tariff by combining a monthly fee to cover fixed costs and a unit-based fee to cover marginal costs.

Table 2
Current State Policies

State	*Require Curbside Recycling*	*Required Recycling Goal*	*Require User Fee*	*Subsidize User Fee*	*Promote User Fee*	*Landfill Tax*
Alabama	X	25%			X	
Alaska					X	
Arizona	X					
Arkansas	X			X		$2.50/ton
California	X	50%			X	$1.40/ton
Colorado						
Connecticut	X	25%			X	$1.00/ton
Delaware					X	
Florida		30%		X		
Georgia		25%				
Hawaii		50%				$0.25/ton
Idaho						
Illinois		25%			X	$2.22/ton
Indiana				X		$0.50/ton
Iowa		50%	X			$4.25/ton
Kansas					X	$1.50/ton
Kentucky					X	$1.75/ton
Louisiana		25%			X	
Maine				X		
Maryland	X	20%			X	
Massachusetts				X		
Michigan						
Minnesota	X	35%	X			$2.00/cubicyard
Mississippi						
Missouri				X		$2.04/ton
Montana					X	
Nebraska	X			X		$1.25/ton
Nevada	X	25%			X	
New Hampshire						
New Jersey	X	60%			X	$8.00/ton
New Mexico					X	
New York	X				X	
North Carolina		25%		X		
North Dakota					X	
Ohio		25%		X	X	$1.75/ton
Oklahoma						
Oregon		varies				$1.24/ton
Pennsylvania	X			X		$6.25/ton
Rhode Island	X	15%			X	
South Carolina		30%			X	
South Dakota	X					
Tennessee		25%				$ .75/ton
Texas				X		$1.25/cubicyard
Utah					X	
Vermont	X	40%				
Virginia	X	25%				
Washington	X		X			
West Virginia	X					$1.55/ton
Wisconsin		35%	X			$3.00/ton
Wyoming					X	

own garbage containers. Only garbage identified with the bag, sticker or tag is collected. These programs became popular beginning in the late 1980s in small towns in Pennsylvania and New Jersey and have more recently been implemented in other regions. The second type of program is a weight-based system initiated in Seattle, Washington, and in some European cities. Garbage trucks are fitted with scales, and collectors weigh each household's garbage and bill that household accordingly. These weight-based systems eliminate the incentive for households to reduce garbage collection expenses by compacting waste into fewer containers. The "Seattle Stomp," as it became known in the literature, is not particularly helpful since most garbage trucks compact household waste anyway. The third type of curbside pricing program is often called a subscription or can program. Residents in these municipalities pre-subscribe to a specific number of cans or to a specific size of can and are billed according to this quantity whether or not the household utilizes the subscribed capacity. These programs have operated for several decades in many municipalities in California, Oregon and Washington. (Some municipalities prefer to issue specific garbage containers of a single size to beautify alleys and driveways and to streamline the process of garbage collection.). The incentive, on the margin, for a household to reduce waste is not as strong with a subscription program as with the other two programs because households generating, say, 1.5 cans of garbage each week would normally contract for 2 cans per week and will thereafter face a zero marginal cost for up to 0.5 cans of additional garbage each week.

The Effect of Unit-Based Pricing

T3 Table 3 summarizes the results of studies that have estimated the change in disposal behavior by households facing unit-based pricing programs. These studies consistently estimate the demand for garbage collection services to be inelastic. Two studies have examined the effects of weight pricing, and both estimated changes in disposal behavior are roughly equal to those of the bag/tag studies. For the subscription programs, studies based on the experience in Marietta, Georgia, show a moderate effect, but most studies show little or no significant effect.

It takes a special kind of household to respond substantially to the implementation of a user fee. Because virtually all municipalities charging user fees had already established a curbside recycling program, many households were already recycling before the user fee was implemented. The most environmentally friendly households were likely to recycle the most, and would therefore find it difficult to reduce waste substantially further following the implementation of a unit-based pricing program. Households comprised of busy professionals or retirees may face high costs to separate and store recyclable material and would simply pay the per-bag charge without engaging in any additional recycling. To change disposal practices substantially, a household must (1) recycle little prior to the user fee *and* (2) face low costs to recycle such that the per-bag fee would tip the margin towards recycling. That unit-pricing programs generally fail to produce much change in disposal behavior suggests that the number of such households is small.

Table 3
Estimates of the Incidence of Bag/Tag Programs

Authors	*Data*	*Program Type*	*Price Elasticity of Demand*	*Pounds of Garbage Reduction per $1 User Fee (per household per week)*
Fullerton and Kinnaman (1996)	Two-period panel of 75 households in Charlottesville, VA	Bag/Tag	−0.08	1.92
Podolsky and Spiegel (1998)	Cross-section of 159 New Jersey municipalities	Bag/Tag	−0.39	9.83
Van Houtven and Morris (1999)	39-month panel of 16 sanitation routes in Marietta, GA	Bag/Tag	−0.15	14.28
Van Houtven and Morris (1999)	Monthly panel of households in Marietta, GA	Bag/Tag	−0.10	11.35
Hong (1999)	Cross-section of 3,017 households in 20 South Korean municipalities	Bag/Tag	−0.15	
Kinnaman and Fullerton (2000a)	Cross-section of 959 towns across the U.S., 114 with unit-pricing	Bag/Tag	−0.28	7.93
Dijkgraaf and Gradus (2004)	Three-year panel of 538 Dutch municipalities	Bag/Tag	−0.43	22.66
Linderhof et al. (2001)	Cross-section of 3,459 households	Weight	−1.10	5.60
Dijkgraaf and Gradus (2004)	Three-year panel of 538 Dutch municipalities	Weight	−0.47	22.89
Van Houtven and Morris (1999)	39-month panel of 16 sanitation routes in Marietta, GA	Subscription	−0.26	4.60
Van Houtven and Morris (1999)	Monthly panel of households in Marietta, GA	Subscription	−0.26	10.56
Hong and Adams (1999)	Panel of 994 households in the Portland metro area	Subscription	−0.01	0.15
Kinnaman and Fullerton (2000a)	Cross-section of 959 towns across the U.S., 114 with unit-pricing	Subscription	−0.01	0.44
Dijkgraaf and Gradus (2004)	Three-year panel of 538 Dutch municipalities	Subscription	−0.06	0.74

Some caution should be taken before comparing the elasticities across empirical studies. Some studies use household-level observations before and after the implementation of a curbside charge, and estimate an arc-elasticity. Other studies utilize a cross-section of municipality-level data and derive point elasticities using the mean price and garbage quantity, which can vary across data sets. To provide a sharper comparison across empirical studies, the absolute change in garbage generation attributable to a $1 curbside user charge is also reported in the final column of Table 3, as a way of controlling for the varying methodologies used to estimate price elasticities. All of these studies estimated the slope of a linear demand curve for garbage collection, which are reported in Table 3 after normal-

izing the units of measurement to pounds per households per week. Thus, a $1 per bag or tag fee reduces household garbage by between 1.92 and 22.89 pounds per week (for perspective, the average household generates about 30 pounds of garbage per week).

Two clear outliers in this group are estimated by Dijkgraaf and Gradus (2004), who use a cross section of 538 municipalities in the Netherlands, 126 of whom have implemented unit-pricing. Unlike every other study in Table 3, this estimate does not control for the presence of a curbside recycling program in each municipality, which is often highly correlated with presence of a unit-pricing program. Thus, the high coefficient may be picking up the aggregate effect of both programs. Kinnaman and Fullerton (2000a) find a curbside recycling program increases recycling by 8.78 pounds per household per week. Crudely subtracting this amount from the Dijkgraaf and Gradus (2004) estimate provides a household response to garbage pricing that is more in line with the rest of the literature.

The Net Benefits of Unit-Based Pricing

The net benefits of implementing a pricing program can be estimated using parameters from a variety of published results. Assume private marginal costs are $40.00 per ton for garbage collection and $40.00 per ton for garbage disposal (Repetto, Dower, Jenkins and Geoghean, 1992). Assume the external marginal cost of garbage collection and disposal is $5.00 per ton (as estimated above, roughly). Thus, the (assumed constant) social marginal cost of garbage collection and disposal, and therefore the efficient curbside price, is roughly $85.00 per ton, or 85 cents per twenty-pound bag. Assume the demand curve for municipal garbage collection is linear and its slope is determined by the empirical estimates given in Table 3 (such that the average household reduces garbage by 12 pounds, or 0.6 twenty-pound bags per week in response to a fee of $1.00 per bag; roughly the mean of the six published results for bag/tag programs given in Table 3). Based on these assumptions, increasing the curbside price of garbage from zero to 85 cents eliminates a dead weight loss of 25.5 cents per household per week, or $13.26 per year. (The area of the dead-weight loss triangle is 0.6 bags times $0.85 per bag divided by 2.) Thus, the total benefits of charging the right price at the curb are sufficient to perhaps pay for one lunch per household per year.

But before each household can enjoy that cost-offset free lunch, the costs to implement and administer the unit-based curbside pricing program must be deducted from the benefits. These administrative costs have been largely ignored by economists. To administer the bag/tag program, bags or stickers need to be produced and distributed to all households. Garbage collectors need to examine each container of garbage. Administrators need to monitor the inventories of bags, tags or stickers and answer questions from households and the retail distributors of the bags, tags or stickers. The municipality must also deter

Fn4 and possibly remove any illegally dumped garbage.[4] The only two formal estimates of these administrative costs are by VROM (1997), which uses data from twelve Dutch municipalities to estimate the bag/tag program costs at $10.22 per household per year and Fullerton and Kinnaman (1996), who use data from a single municipality to estimate the program costs at $12.05 per household per year. Subtracting these costs from the total benefits leaves very low net benefits of just a few dollars per household per year. If costs to deter or remove illegally dumped garbage were included, net benefits could be negative.

Weight-based systems are much more costly than bag/tag programs to administer because scales must be installed on all collection trucks and labor costs increase as workers weigh each garbage container separately. Furthermore, and as summarized in Table 3, weight-based systems induce households to reduce garbage by about the same magnitude as bag/tag programs. Perhaps for these two reasons, weight-based programs are far less common than bag/tag programs, even though they discourage households from engaging in the "Seattle Stomp" as a method to reduce garbage bills.

To administer the subscription programs, the municipality must provide each household with a certain number of specific-sized containers and bill them accordingly. The municipality must also keep an adequate inventory of various sized cans as households change occupants or family size and thus their subscription. The Netherlands Ministry of Housing, Spatial Planning and the Environment estimates that the administrative costs of operating a municipal subscription program are $13.81 per household per year—again, roughly the same size as the benefits (VROM, 1997).

Lessons from the Private Sector

Some municipalities relegate garbage collection services to the free market, where households contract independently for garbage collection services. These private collectors apparently agree that the benefits of unit-based pricing for garbage are small, because they almost universally provide unlimited access to their collection services for a single fixed price. Private collectors (as well as virtually every municipal collector) often apply a per-unit curbside fee for the collection of bulky items such as old mattresses, old stoves, refrigerators and washing machines. In these cases, the cost of measuring whether a household must pay the extra cost is low (simply counting either zero or one of these items in almost all cases) and the variance across households in the cost of collecting and disposing of these items is

[4] The possibility of increased illegal dumping is often mentioned as a cost of implementing a unit-based pricing program. Communities with easy opportunities for dumping, such as those with dense inner-cities or with unpopulated rural roads, have rarely adopted unit-pricing perhaps to avoid the problems associated with dumped garbage. Most unit-based pricing programs have been implemented in suburban areas or in small towns where per-capita income levels are high and few convenient dumping sites exist. Data on illegal dumping from these self-selected communities are not readily available. But Fullerton and Kinnaman (1996) use household questionnaires and observed garbage quantities to estimate that 38 percent of the reduction in waste attributable to unit-pricing may have been dumped in Charlottesville, Virginia.

high. (The costs are zero for most households and rather high for the few households presenting one of these items). Thus, from a general business perspective, per-unit curbside pricing programs appear to make sense for occasionally bulky items, but in most cases not for ordinary weekly garbage collection.[5]

That 4,000 municipalities have implemented curbside user charges suggests they are either uninformed or have adopted unit-based pricing to serve some goal other than reducing quantities of garbage. In fact, municipalities in California, Oregon and Washington were using the subscription method to finance the costs of garbage collection long before concerns over excess garbage arose in the 1980s.

Other municipalities have had no choice but to implement unit-based curbside pricing programs. The states of Washington and Minnesota require the adoption of these programs (as listed in Table 2). Wisconsin and Iowa also require them, but only if a municipality has not reached a mandated recycling goal. Several states provide financial incentives for adopting unit-pricing programs.[6]

Updating Policy Prescriptions

Many states and municipalities have adopted curbside recycling to reduce garbage totals. With the considerable heterogeneity across municipalities in the costs and benefits of curbside recycling, the state mandates calling for these programs likely subtract from welfare in many municipalities. Replacing these state regulations with unit-based charges for garbage collection would result in small benefits, at best.

The facts and analysis in this article argue for the elimination of state mandatory recycling and state unit-pricing laws. But regulatory control should not be returned to individual municipalities until the external costs of their disposed garbage are fully internalized. The easiest way to internalize these costs is with a rather modest landfill tax set equal to the external marginal cost of solid waste disposal ($5.38 to $8.76 per tons estimated above, and reduced by any "host fees" already paid to the local area by the landfill). This tax would be inexpensive to administer and unlikely to cause illegal dumping. (It may be harder for municipal and private garbage collectors to avoid the tax by dumping, as some individual households will do.) Recall that municipal recycling also reduces the demand for raw materials. This benefit of recycling is internalized by the recycling municipality through market prices for recycled materials, assuming firms extracting raw materials internalize all of their own costs. If the extraction of raw materials generates external costs, then appropriate regulatory measures are necessary within that industry.

The last column of Table 2 provides a list of the 20 states that currently levee a landfill tax. New Jersey has implemented the largest tax of $8.00 per ton followed

[5] Private waste collectors also apply a lower cost version of the subscription program. Households using these private collectors subscribe for a specific number of cans but use their own containers.

[6] The central government of South Korea in 1995 also made unit-based pricing programs mandatory in 1995 throughout the country, though municipalities can choose their own curbside price. Hong (1999) studies this program.

by Pennsylvania with a tax of $6.25 per ton. Other states have implemented landfill taxes in the $1.00 to $2.00 range. Based on a casual review of the relevant state laws, these taxes seem to have been implemented, not to ensure that municipalities internalize disposal costs, but to obtain revenue to provide grants to municipalities to finance the costs of curbside recycling programs and other environmental improvement projects.[7]

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In some cases, landfill disposal fees will cause cities to adopt curbside recycling. Kinnaman and Fullerton (2000a) find that a $1.00 increase in the tipping fee increases by 0.78 percent the likelihood a municipality chooses to adopt a curbside recycling program, and by 3.5 cents the optimal price per bag to charge at the curb. Tawil (1995) also finds that economic variables increase the likelihood that a municipality will adopt curbside recycling, but Kinnaman (2005) finds no relationship between tipping fees and a municipality's decision to adopt curbside recycling.

But because both the operating costs and benefits to households of curbside recycling programs vary across municipalities, local policy decisions should also vary. If the external costs of garbage disposal were to be internalized through the landfill tax, state mandates that require municipalities to adopt curbside recycling, to achieve a recycling target, or to implement unit-based fees for garbage pick-up would be unnecessary and could be eliminated.

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[7] Several member states of the European Union have also initiated national landfill taxes. The United Kingdom introduced a national landfill tax in 1996. This tax was originally equal to the external marginal cost of garbage disposal (about £7 per ton) to obtain efficient garbage quantities. The UK subsequently increased the tax first to £10 in 1999 and then by £1 per year until it reached £15 per ton in 2004. These tax increases were passed not to reflect rising external marginal costs but to reduce garbage in order to satisfy the European Union's landfill directive that mandates a 20 percent reduction in landfill use. The UK has also recently implemented a tradable permit scheme to satisfy this directive. Municipalities with low solid waste abatement costs can trade rights to dispose waste in the landfill to other municipalities. The Netherlands introduced a landfill tax of 13.27 euros in 1995, and France established a landfill tax in 1993 and subsequently tripled it to EUR 9.15 per ton in 1995. Sweden initiated a EUR 30 per ton tax in 2000 and subsequently increased the tax to EUR 40 per ton in 2002. Although conditions in Europe affecting costs and benefits are assuredly different than in the United States, these taxes appear to exceed considerably the external marginal cost of garbage disposal estimated above.

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