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Explaining the Growth in Municipal Recycling Programs: The Role of Market and Non-Market Factors

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RESEARCH & THEORY

EXPLAINING THE GROWTH IN MUNICIPAL RECYCLING PROGRAMS
The Role of Market and Nonmarket Factors

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The implementation of thousands of municipal recycling programs in the United States has increased recycling's portion of solid waste from 10% to 30% over the past decade. But the lack of accurate data has spurred a debate over whether the growth in recycling can be attributed to market or nonmarket factors. To address this issue, this article conducts a benefit-cost analysis of a municipal recycling program. Results suggest recycling is costly. So why, then, does it remain popular? This article suggests that local governments could be responding to households that perceive a benefit from recycling services. These benefits are estimated with a contingent valuation survey.

The portion of municipal solid waste that is recycled in the United States has steadily increased from approximately 10% in 1989 to 30% in 1997. This trend can be attributed primarily to the implementation of more than 8,000 municipal curbside and drop-off recycling programs over this period (Glenn, 1998). Currently, 46% of Americans have access to curbside recycling, and many more have local access to drop-off facilities. Clearly, the rapid growth in municipal recycling programs can be considered one of the more significant environmental policy movements over the past decade.

An interesting policy question is the extent to which this recent growth in municipal recycling programs can be attributed to market factors. Casual evidence supports such a link. First, recycling is most common in the northeast region of the United States where solid waste disposal costs (tipping fees) exceed those in other regions of the country. Second, the growth in recycling has come on the heels of increases in solid waste transportation costs that began when municipalities started to shift garbage disposal from local town dumps to remote regional landfills.[1] However, the original data employed by this article to estimate the market benefits and costs of operating a municipal recycling program show that costs to collect and process recyclable material exceed the benefits from selling the collected materials and from taking less garbage to the landfill. Therefore, if recycling is indeed expensive, then nonmarket factors must have also played a role in the past decade's growth in recycling. One potential nonmarket factor

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could be a reduction in the external costs of traditional garbage disposal attributable to the extra recycling. Garbage disposal is a messy practice: Landfills emit foul odors and threaten area ground water supplies, and incineration produces air pollution and toxic ash. But these disposal practices increasingly occur in rural settings at some distance from the municipality (see Note 2). Municipal governments might not worry about these environmental costs if garbage is "exported" to surrounding regions.

Since neither market nor environmental factors seem to fully explain the growth in recycling, this paper suggests and tests a third factor. Municipal recycling programs, like other municipal services such as parks and recreational facilities, could provide some kind of direct benefits to local residents. Local governments may have implemented recycling programs in response to these benefits; if households benefit, the program need not pay for itself. Results from a contingent valuation survey of local households support this claim.

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The Benefit-Cost Data

Recall that the first contribution of this article is to estimate the market benefits and costs of municipal recycling programs. If market benefits exceed costs, then the growth in recycling could be attributed to such factors. But reliable benefit-cost data are difficult to obtain by either of two available strategies. The first strategy takes advantage of the fact that some state government recycling offices keep cost records for all of their state's recycling programs to award municipalities grants to reimburse their recycling expenses.[2] Each of these records could be combined to form a cross-sectional data set of recycling costs. But municipalities differ over procedures used to budget recycling expenses. Some local governments include the capitalized cost of unused landfill space, whereas others do not. Some local governments include the cost of garbage collection when the same truck collects garbage and recycling; others do not. A few include the opportunity cost to employ municipal resources to store recyclable materials, but most do not. Based on survey responses from 102 municipal solid waste officials, Savas (1979) estimates that actual solid waste collection costs are 30% higher than municipal accounts indicate. Folz (1999) also reports a considerable variation in how municipalities estimate their own recycling costs. For these reasons, a cross-sectional data set may prove unreliable for an accurate estimate of the market costs and benefits of recycling.[3]

A second and perhaps more accurate method of obtaining benefit-cost data is to collect it directly from individual communities. This case study approach has been employed in studies done by trade associations within the solid waste industry such as the Solid Waste Association of North America (SWANA) (1995). The SWANA study finds that the market costs of curbside recycling in six communities in the United States average $74 per ton more than the cost of traditional landfill disposal. Hanley and Slark (1994) conducted a benefit-cost analysis in a single town in Scotland. They estimate the quantifiable market and nonmarket benefits of newspaper recycling exceed the market costs. Therefore, little consensus has been reached on estimating the costs of municipal recycling programs within the economics literature.

This study utilizes the case study approach to gather data but adds considerable detail to existing efforts. Original data are gathered to estimate virtually all of the direct program costs and benefits of operating a single recycling program. Intensive interviews were conducted with local officials. Several on-site visits and inspections of every step of the recycling process took place. Government account ledgers were reviewed when necessary, but total costs were estimated using economic rather than accounting principles. As should become apparent below, many of the benefits and costs of recycling included in this study would be impossible to measure without such a thorough data-gathering process. Thus, one contribution of this article is the provision of more accurate recycling benefit-cost data.

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The data were gathered in Lewisburg, Pennsylvania, a municipality located along the Susquehanna River in the central part of the state. Lewisburg has operated a drop-off facility for several materials since the early 1980s. In 1988, the municipality voluntarily implemented a curbside recycling program in which newspapers and aluminum were collected each month

Table 1: A Statistical Comparison of Lewisburg to the State and Nation

	Income[a]	*Education*[b]	*Education*[c]	*Density*[d]
Lewisburg	26,123	83.7	34.2	5,785
Pennsylvania				
Urban	24,859	75.2	20.1	
Urban fringe	26,541	81.0	24.3	
Small towns[e]	21,234	73.4	14.2	
Nation				
Urban	25,381	76.6	22.6	
Urban fringe	27,607	81.6	25.5	
Small Towns[e]	20,959	70.8	14.6	
Pittsburgh				6,652.5

NOTE: Data are from the 1990 U.S. Census.
a. Among year-around full-time workers.
b. Percentage high school graduates among those older than 25.
c. Percentage college graduates among those older than 25.
d. Persons per square mile.
e. Places with populations between 2,500 and 9,999.

from households. Thus, Lewisburg's program was fairly mature in 1996 when cost data were gathered.

In 1991, Lewisburg was required by the commonwealth of Pennsylvania to pass a local ordinance making the recycling of certain materials mandatory for households and businesses.[4] Because of this law, households in Lewisburg are now required to recycle glass as well as newspaper and aluminum. Curbside collection of these materials is provided once per month at no fee to households,[5] but enforcement of the ordinance is weak: garbage handlers simply periodically inspect the contents of garbage and refuse to collect material that contains recyclables.[6] Lewisburg also provides drop-off facilities that accept bi-metal cans, magazines, and 1-gallon plastic milk jugs and 2-liter plastic beverage containers. No curbside collection of these materials is provided. Residents and firms in Lewisburg recycled a total of 334.46 tons of material in 1995, representing 11.59% of the total waste stream.[7]

Although a small town, Lewisburg's demographic characteristics resemble to some extent those of larger cities and (especially) their suburbs.

Although a small town, Lewisburg's demographic characteristics resemble to some extent those of larger cities and (especially) their suburbs. Using U.S. Census data, Table 1 compares the income and education level of an average individual older than 25 years of age in Lewisburg with the average individual older than 25 residing in other types of communities. The average full-time worker in Lewisburg makes $26,123 dollars per year, which compares favorably to the average full-time worker in an urban suburb (termed "urban fringe") and is more than $5,000 more than the average person in other small towns across the country. Similar comparisons can be made with education levels. The percentage of individuals older than 25 years of age in Lewisburg with a high school (83.7%) or college (34.2%) degree resembles most the education levels attained in an urban fringe area.[8]

Lewisburg's population density is also somewhat unique among small towns. Because Lewisburg's housing stock is composed of Victorian town homes located adjacent to one another, the population density of 5,785 per square mile resembles the density of Pittsburgh's. If the cost of collecting recyclable material is a function of the population density, then cost data gathered in Lewisburg could also be useful to estimate costs in larger communities.[9] However, larger communities could enjoy economies of scale (Bohm, Folz, & Podolsky, 1999).

The Market Benefits and Costs of Municipal Recycling

The market benefits of Lewisburg's municipal recycling program are (a) the revenue earned from the sale of the recycled materials and (b) reductions in garbage collection and disposal costs. The market costs of the program include costs to collect, process, store, and deliver the

TABLE 2: The Net Operating Cost Differential of Recycling

	Amount (dollars)
Direct Program Benefits	
Reduced disposal costs (334.46 tons times $47 per ton)	15,719.62
Reduced solid waste transportation costs	1,539.03
Sale of recycled materials (see Table 3 for prices and quantities)	9,125.90
Total	26,384.55
Direct Program Costs	
Collection/delivery costs:	
Curbside collection from households	4,080.00
Processing costs:	
Labor cost to receive corrugated boxes and office paper	2,080.00
Labor cost to receive aluminum, glass, bi-metal cans, plastic	2,320.00
Routine maintenance for glass shredder	370.00
Storage costs:	
Rent on tractor trailer to store corrugated boxes and office paper	3,600.00
Rental cost for storage space for plastic	1,650.00
Rental cost for storage space for magazines	325.00
Opportunity cost of municipal warehouse to store glass and aluminum	1,740.00
Transportation costs:	
Cost to ship glass to market	2,750.00
Cost to ship aluminum to market	1,645.11
Cost to ship plastic and bi-metal cans to market	960.00
Administrative costs:	
Three hours per week devoted to recycling by borough manager	2,500.00
Advertising costs	1,303.76
Capital costs:	
Original purchase price of glass crusher (at $2,750.00)	
Original purchase price of newspaper shredder (at $49,171.00)	
One-time upgrade to newspaper shredder[b] (at $22,196.00)	
Annual rental cost of capital (5% of $74,117.00)	3,705.85
Total	29,029.92
Net operating cost differential	–2,645.37

a. This cost was estimated using market data for collection costs. (PLEASE DELETE THIS NOTE OR INSERT A SUPERSCRIPT a IN TABLE TEXT)

b. Buyer of newspaper needed upgrades to make shredding and bailing of newspaper more efficient.

materials to secondary markets. Market costs also accrue to recycling firms and households. Each of these benefits and costs are estimated and discussed separately below.

MARKET BENEFITS TO THE MUNICIPAL GOVERNMENT

Market benefits that accrued to Lewisburg's economy in 1995 from the implementation of the recycling program are provided in Table 2. A significant benefit of the recycling program was the reduction in disposal costs paid at the landfill. The municipality saved $15,719.62 (334.46 tons recycled times the local tipping fees of $47 per ton). If the landfill internalizes the scarcity value of landfill space (Hanley & Slark, 1994), then the tipping fee reflects the cost of purchasing new land once the current landfill is full. If the tipping fee does not reflect the costs of new land (which is likely for publicly owned landfills), then the private cost of garbage disposal is underestimated by the tipping fee.

A second benefit arose from taking fewer deliveries of solid waste to the landfill. Municipal garbage trucks made 432 trips (delivering 2,917.02 tons of garbage) over the year prior to mandatory recycling and 345 trips (delivering 2,631.55 tons) over the year following its implementation, saving 87 trips. Based on the average gas mileage of garbage trucks, the municipality saved an estimated $11.99 for each 30-mile roundtrip, implying total savings of $1043.13 in 1995. The drivers were salaried, so labor costs did not decrease; nor did the municipality enjoy

Table 3: Prices and Quantities of Each Material Recycled

Material	*Price*[a] *(per pound)*	*Household Quantity (in pounds)*	*Firm Quantity (in pounds)*	*Extra Services Included in Price*
Corrugated boxes	$0	3,884	193,703	Transportation and processing
Mixed office paper	$0	0	24,907	Transportation and processing
Magazines	$0	27,268	30	Transportation and processing
Aluminum	$0.54	5,740	353	None
Glass	$0	—	12,198[b]	Transportation and processing
Brown	$0.015	47,900	—	None
Green	$0.015	25,940	—	None
Clear	$0.0225	204,340	—	None
Newspaper	$0	88,000	0	Transportation
Bi-metal cans	$0.0085	15,345	0	None
PET plastic (milk jugs)	$0	10,691	0	None
HDPE plastic (coke bottles)	$0	7,035	0	None

a. Denotes price received by the municipality.
b. Data for glass collected from businesses by private haulers does not specify color. Private haulers market this glass directly.

lower insurance rates on garbage trucks. But the 20% reduction in the number of trips to the landfill may have imposed less wear and tear on the garbage trucks. Trucks of similar size rented for $0.19 per mile in a competitive truck-renting market. Using this figure to estimate the depreciation to a truck from an additional mile, $5.70 per trip ($495.90 per year) was saved.

A third direct program benefit of curbside recycling was the provision of recycled materials to the economy. In competitive markets, the economic value of each material is estimated by its price.[10] The price paid to the municipality for each material is provided in the second column of Table 3. The material was purchased by either an intermediate or final buyer.[11] Any extra services provided by an intermediate buyer are listed in the fifth column of Table 3. The costs of providing these extra services do not need to be estimated separately because they are incorporated (or internalized) into the lower price paid to the municipality for the materials.

An estimate of the value of all recycled material is obtained by multiplying the price received by the municipality for each material by the quantity of each material recycled. A total of $9,125.90 worth of materials was sold. The summation of the market benefits from reduced disposal costs, reduced trips to the landfill, and the sale of recycled materials amounted to $26,384.55. These benefits will be compared with the market costs of recycling described in the next sections.[12]

MARKET COSTS TO THE MUNICIPAL GOVERNMENT

The recycling process required (a) the collection of recyclable materials from the curbs of households, (b) the processing and storage of these recyclable material at the municipal recycling center, and (c) the transportation of these materials to final markets. Administrative resources were also required to oversee the process. The costs of each of these steps are also given in Table 2 and discussed below.

The municipality paid a hauling firm $4,080 in 1995 to collect glass, aluminum, and newspaper once per month from households. Glass and aluminum were processed and stored in a 560 square foot warehouse owned by the municipality. Although the municipality does not pay rent for the use of this warehouse, it foregoes the opportunity to rent the warehouse space to others. The competitive rental cost of comparably sized storage space was $1,740 per year (and several storage companies were sold out of lots this size).

Dropped-off materials must also be received and stored. Plastics dropped off by households were stored at a separate facility not owned by the municipality at a cost of $1,650 per year. A tractor-trailer bed was rented at an annual cost of $3,600 to receive and store corrugated boxes

and office paper dropped off by businesses and households. Magazines were stored separately at a cost of $325 per year. The cost of labor necessary to monitor the drop-off facilities and receive materials amounted to $4,400 per year.[13]

The municipality chose to crush glass and aluminum to reduce transportation costs. This light processing occurred in the municipality-owned warehouse described above. The municipality initially paid $2,750 for a crusher and paid an average of $370 each year to maintain it.[14] The crushed glass, crushed aluminum, plastic, and other materials were transported to final buyers at a cost of $5,355.11.

Newspaper is shredded separately for use as animal bedding by local farmers. The municipality agreed to purchase a newspaper shredder for a large local farm at a cost of $71,367. In exchange, the farm agreed to collect the newspaper from the recycling center each month and to pay all routine maintenance involved with the shredder.

The costs of the glass crusher and the paper shredder comprise the only significant fixed costs of the recycling program. The $74,117 used to pay these up-front costs could have been invested. Assuming a potential 5% real rate of return, the capital costs amounted to $3,705.85 per year. Administrative costs consisted of the value of 3 hours per week allocated by the borough manager to recycling and advertising expenses paid to promote the program each year.

According to these data, the total costs of the recycling program amounted to $29,029.37. Thus, the market costs of the municipal recycling program exceeded the benefits by $2,645.37. The market cost to recycling firms and households will be added to this figure below.

MARKET COSTS TO RECYCLING FIRMS

If local ordinances require firms to recycle certain materials, such as corrugated boxes and mixed office paper, these costs should be factored into the benefit-cost calculus. Many of the municipal recycling programs in operation in this country (including Lewisburg's) contain such local ordinances.

If local ordinances require firms to recycle certain materials, such as corrugated boxes and mixed office paper, these costs should be factored into the benefit-cost calculus. Many of the municipal recycling programs in operation in this country (including Lewisburg's) contain such local ordinances. And whether these materials are taken to a drop-off location in the borough by businesses themselves or taken away by a private hauler, the mandate to recycle involves the use of resources that have been ignored by previous estimates of recycling costs. Municipal government officials facing reelection could internalize these costs if local firms vocalize their displeasure with the municipal recycling program or if local consumers complain after facing the resulting higher prices.

Three private haulers competed in Lewisburg for the delivery of recyclable materials. Two of the three haulers provided price information, and both charged $20 per delivery for a large pick-up load (about 6 square yards). The municipal government documented each of the 362 deliveries of commercial recyclables in 1995. Assuming competition in the collection industry (where price is equal to marginal cost), the value of economic resources allocated to deliver recyclable material amounted to $7,240.

Most businesses self-delivered recyclable materials to the recycling center. According to government records, 866 self-deliveries were made in 1995. The value of each firm's resources devoted to the self-delivery of recyclable materials is not observed. However, it can be assumed that delivery costs must have been less than $20 per trip or these firms would have hired one of the three private haulers to take delivery. Assuming an average cost of $10 per trip implies the total cost of self-delivering recyclable materials is $8,660. Thus, the cost to local firms is estimated at $15,900.[15]

MARKET COSTS TO RECYCLING HOUSEHOLDS

Recycling also involves the use of scarce household resources (such as time and storage space) that could have been allocated to other uses. Jakus, Tiller, and Park (1996) use survey responses to estimate that it takes an average of 36 seconds to recycle newspaper and 54 seconds to recycle glass. Schaumberg and Doyle (1995) assume households take 5 minutes per week to prepare all recyclable material. Assuming a cost of labor of $7.50 per hour, this cost amounts to

Table 4: Values of Disposal Fee, Price Index of Recycled Materials, and Recycling Costs That Allow Recycling to be Cost-Effective

	Necessary Value of Disposal Fee With:[a]			
Recycled Materials Price Factor[b]	*Current Program Costs*	*10% Cost Reduction*	*20% Cost Reduction*	*30% Cost Reduction*
1.00	102.45	89.01	75.58	62.15
1.25	95.63	82.19	68.76	55.33
1.50	88.81	75.37	61.94	48.50
1.75	81.98	68.55	55.12	41.68
2.00	75.16	61.73	48.30	34.86

NOTE: This table reads as follows. If recycling costs were to decrease by 10%, and if prices of all recycled materials increased by 25% (price factor of 1.25), then the recycling program would be cost-effective if the disposal fee were to rise to $82.19 per ton.

a. Current disposal fee is $47.00.

b. Current price factor is 1.00. Simply multiply the price factor by current prices of recycled materials to get threshold prices. Current price of aluminum is $0.54 per pound; current price of clear glass is $45 per ton. The current price of bi-metal cans is $17 per ton.

$60 per ton. Reschovsky and Stone (1994) find that households reporting adequate storage space are much more likely to report on a mail survey that they recycle.

These costs are not included in the benefit-cost analysis here because they will be incorporated indirectly in the responses obtained by the contingent valuation study below. For example, if a household reports that it is willing to pay $5 per quarter for municipal recycling services, then this household can be assumed to enjoy the recycling program by at least $5 more than their resource costs or they would have declined the offer to pay that amount. The results of the survey are described more carefully below.

AN ANALYSIS OF THE MARKET BENEFITS AND COSTS

Combining the $2,645.37 paid by the Lewisburg municipal government in 1995 with the $15,900 paid by local firms for delivery implies the local economy's total out-of-pocket expenses amounted to $18,545.37 (an average of $10.35 per Lewisburg household). When broken down by tons, the Lewisburg economy paid an average of $102.45 per ton to recycle the material—$55.45 per ton more than the cost of disposing that material in the landfill. These costs would not have accrued to the economy in the absence of the recycling program.

Two general points can be made based on this result. First, recycling is a costly local service. Waste removal costs could decrease by utilizing the lower-cost landfill rather than operating a recycling program. Second, this cost estimate almost doubles the $10,106 "reimbursement" grant received by Lewisburg from the commonwealth of Pennsylvania's recycling office. The value of that grant was based on the quantity of each type of material recycled, not on actual costs. Given the thoroughness of this study's data collection effort, state-generated cross-sectional cost data may be inaccurate, providing added argument for the need to gather data on a case-by-case basis.

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Could recycling ever pay for itself? Perhaps, but the value of at least one of the variables used in the analysis above would need to change for the costs of municipal recycling to equal zero. For example, benefits would increase if the tipping fee or the prices paid for recycled materials were to increase. Costs of collecting, processing, storing, and transporting recyclable material might also fall. Table 4 provides threshold values of the tipping fee, a price index of recycled materials, and program costs that would allow the recycling program to finance itself. At current prices and program costs, the tipping fee would have to roughly double to $102.45 per ton for curbside recycling to pay for itself. The tipping fee would have to rise to only $62.15 if collection costs fell by 30%. An increase in the price of materials could also make recycling cost-effective. For example, if prices increased by 50% (a price index of 1.50), the recycling

program would pay for itself without a change in collection costs if the tipping fee increased to $88.81. A number of other combinations provided in Table 4 could also allow the out-of-pocket recycling expenses to equal zero. At the current tipping fee of $47 per ton, prices of materials would have to double (price factor of 2.00) and collection costs would have to decrease by 20%.

Many of these changes may be difficult to achieve.

Many of these changes may be difficult to achieve. The highest state-averaged tipping fee in the country is $61 per ton in New Jersey (Glenn, 1998). Material prices have increased but have not sustained their higher levels. Increases in the technology of collecting and processing recycled materials could decrease costs, and many advocates of curbside recycling emphasize these possibilities. But with the recent fall in tipping fees in the northeastern United States, prospects appear dim for the self-financing of municipal recycling.

Note that a significant component of the costs of the program is the delivery of corrugated boxes and office paper by commercial establishments to a drop-off center. The commonwealth government of Pennsylvania (as well as a handful of other states in the northeast) mandates such activity. As illustrated in Table 3, 118.33 tons of Lewisburg's recycling efforts (35%) was based on the involuntary recycling efforts of local firms. If the mandatory ordinance requiring participation among firms were eliminated, direct costs to the local government would fall by $5,680 (since the municipality would no longer need to receive or store corrugated boxes and office paper). Direct costs to local firms would fall by the previously estimated $15,900. Direct benefits would also fall by an estimated $6,296.73, because those previously recycled materials would have to be instead transported and disposed in the landfill. Thus, the entire cost of the program would fall from $18,545.37 to only $3,262.10—only $1.82 per household per year. Possible policy implications are (a) states eliminating the requirement that firms recycle or (b) municipalities engineering a more efficient method to collect those materials.

Alternative Explanations for the Growth in Recycling

Although the economics literature has yet to reach a consensus on a single cost estimate of recycling, nearly all studies suggest recycling is costly. Why, then, does municipal recycling remain popular if local economies are in fact losing money from operating these programs? This section provides alternative explanations.

First, local and state policy officials may be pursuing policy objectives with incomplete information. Perhaps once local and state officials are aware of the full costs of these programs, they will slowly begin to eliminate them. Some casual data supports this claim. The District of Columbia had recently temporarily suspended its recycling programs, citing higher than expected costs. Eleven states have also reported a decrease in the number of curbside recycling programs in 1997 (Glenn, 1998), perhaps due to updated information on the costs. But the general trend toward recycling is still one of growth. The state of Ohio recently reported 86 new municipal programs began operation in 1997, and three other states reported the addition of more than 20 programs, bringing the nation's total to nearly 9,000 programs. Clearly, 9,000 municipal governments haven't miscalculated the market benefits and costs of recycling.

Second, perhaps local policy officials have implemented municipal programs to satisfy an objective other than the pursuit of market benefits. Municipal recycling programs are expected to produce environmental benefits, and local governments are surely aware of it. Increases in recycling are expected to reduce the external costs associated with landfill disposal and incineration, and also reduce air and water pollution.[16] According to Franklin Associates (1994), the use of recycled over virgin inputs in manufacturing is estimated to reduce 10 types of air emissions and 8 types of water effluents, even accounting for the extra emissions from curbside collection and processing practices. The greatest reductions would occur for carbon dioxide, methane, particulate matter, nitrogen oxides, and sulfur oxides. Using those estimates, Lewisburg's recycling activities are estimated to decrease carbon dioxide emissions by 434 tons and sulfur dioxide emissions by 2 tons.

As indicated in the introduction, however, the citizens of a community that is considering the implementation of a recycling program do not enjoy these external benefits. Most municipali-

Most municipalities dispose garbage in regional landfills located several miles away, and the reduction in air and water pollution occurs in manufacturing regions in other parts of the state or country. In fact, only the environmental costs of municipal recycling services such as extra congestion and truck pollution are local to the community.

ties dispose garbage in regional landfills located several miles away, and the reduction in air and water pollution occurs in manufacturing regions in other parts of the state or country. In fact, only the environmental costs of municipal recycling services such as extra congestion and truck pollution are local to the community. Individuals far from the municipality enjoy the environmental benefits. Local governments cannot be expected to voluntarily incur local environmental problems to produce such benefits for others.

Perhaps because of this logic, seven state governments have passed legislation requiring all communities to implement curbside recycling programs and another 15 provide financial incentives (Glenn, 1998). These laws are often accompanied by state grants designed to finance local recycling efforts. An example of such a law is Act 101, passed in 1991 by the commonwealth of Pennsylvania. This law has had a tremendous impact on the number of municipal recycling programs operating in the state. Prior to Act 101, 245 towns recycled only 414,000 tons in Pennsylvania. By 1993, after the full effects of the law were realized, 755 curbside recycling programs were recycling 1,710,000 tons of material.[17]

Perhaps, then, the growth in municipal recycling is not a function of local decisions but of the implementation of these state laws with the accompanying grants. For example, Lewisburg's grant of $10,106 exceeded the market costs of recycling to the municipality ($2,645.37). Indeed, 5,221 of the 8,937 municipal curbside programs nationwide (58.4%) operate in states with such laws and grant programs (Glenn, 1998). These laws and grants provide a powerful descriptor for the national trend. But what drove the local decisions of the other 3,500 communities and the portion of the 5,221 communities that chose to implement a recycling program prior to the implementation of any state law? A final explanation given in this article for the growth in municipal recycling programs relates to local government responses to the preferences of their citizens. The next section explores this option.

Nonmarket Benefits to Households

Could households directly value the ability to recycle? If so, then political benefits could accrue to local politicians that adopt recycling programs (West, 1990). Municipal governments could devote resources to recycling programs to satisfy the demands of their citizens, just as they do with other municipal services such as parks and recreational facilities.

But how do residents benefit directly from recycling services? Households may altruistically dislike contributing garbage.

Because a municipal recycling program simplifies the household's recycling effort, the household would encourage its government to implement one.

But how do residents benefit directly from recycling services? Households may altruistically dislike contributing garbage. These tastes could arise either from some endowed sense of civic duty or to avoid the perception of harming the environment.[18] Households endowed with such preferences can be expected to devote scarce resources to recycling even in the absence of a legal or economic incentive. Indeed, Fullerton and Kinnaman (1996) find that 73.3% of households lacking such incentives regularly participate in a recycling program. Because a municipal recycling program simplifies the household's recycling effort, the household would encourage its government to implement one.[19]

A contingent valuation study was conducted in Lewisburg to estimate the household's value (willingness to pay) for the municipal recycling program described above. A sample of households was randomly selected from the local directory.[20] These households were telephoned and told that a $5 donation would be made to a local charity of their choice if they responded to a few questions about recycling. The response rate was nearly 83%.[21]

The questions and results of the survey appear in the appendix. Seventy-five percent of households surveyed indicated they normally participated in the curbside recycling program. Most households recycled because they believed recycling was good for the environment rather than through a sense of civic duty, though 33% of households could not choose between these two options. A majority of households also believed that storing material was the most difficult aspect involved with recycling. Difficulty in cleaning and separating materials and remembering the correct day to produce materials at the curb were problems identified by a smaller percentage of households.

Responses to Question 6 are important for the estimation of nonmarket benefits to households. Households previously paid $31.35 each quarter for regular garbage collection. Each household was asked whether it would prefer to pay an extra amount that could be added to the quarterly waste bill (either $2, $3, $5, $10, or $20, determined randomly) or abandon the recycling program.[22] All but one of the households presented with the $2 fee was willing to pay the extra fee, whereas 17 of 20 presented with a $3 fee would pay it. But only 12 of the 20 households would pay a $20 fee.[23]

A maximum likelihood procedure developed by Cameron and James (1987) was used to estimate the household's willingness to pay for the recycling program based on the yes/no responses to Question 6. Assuming a normal distribution, the average willingness to pay is estimated at $23.12 per quarter (with a standard error of $14.48), or $92.48 per year.[24] As described above, logic indicates that this figure is net of any household resource costs incurred while recycling.[25]

Because contingent valuation surveys are based on responses to hypothetical questions, some question their validity. Other forms of evidence are provided here to support the notion that households value (and would be willing to pay for) the ability to recycle. First, private firms have profited from providing private curbside recycling services in towns without a municipal collection program. For example, private recycling firms (with clever names like "Paper Chase" and "Trash Rehash") were relatively successful in several Virginia cities in the early 1990s before the implementation of free (to the household) municipal programs drove these firms out of the industry. Second, several municipalities have presented households the option of paying a recycling surcharge in their garbage bills in exchange for the collection of recycled materials. Officials from the City of Richmond, Virginia, report than more than half of their residents agreed to pay $2.00 per month for optional recycling services. Third, evidence for these benefits can be gathered by assessing the value of resources employed by households to voluntarily transport recyclable material directly to markets or drop-off centers in the absence of a municipal collection program. Empirical evidence suggests this amount is not zero.[26] Finally, Tawil (1995) and Kinnaman and Fullerton (in press) both use large cross sections of municipalities to estimate the probability that a municipality chooses to implement curbside recycling. Tawil (1995) finds the probability is based not only on financial costs but also on the percentage of the local population with membership in environmental organizations. Kinnaman and Fullerton (in press) find that market and nonmarket variables (like the average education level of local residents) impact the likelihood of municipal recycling. These various sources all support the notion that households value the ability to recycle and are willing to pay for such services. Municipal governments might be responding to these preferences by implementing curbside programs.

Policy Implications and Concluding Remarks

This article first conducted a careful investigation of the direct benefits and costs of recycling in a single municipality to test whether market factors could contribute to the growth in municipal recycling programs. The direct costs of operating a municipal recycling program are estimated to exceed the benefits by roughly $55.44 per ton, or $10.35 per household per year. Although representative of just one municipality, this estimate is perhaps the most thoroughly researched in the literature and further confirms the notion that recycling is a costly government service.

Unknown to many economists is why governments continue to implement such programs in the face of their costliness. Alternative reasons requiring local governments to either be misinformed or altruistic are unconvincing. This article tested a third factor: The growth in recycling can be attributed to local government's response to the preferences of households. The results of a contingent valuation survey indicated households on average are willing to pay $92.48 each year for the municipal recycling program. Other sources of evidence confirm this notion. Perhaps the decisions of local governments are made partly to address these preferences.

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Orthodox practitioners of benefit-cost analysis could argue that the results of this study suggest that municipal recycling programs are efficient because the nonmarket benefits to the average household (estimated here at $92.48 per year) exceed the market costs to the average household ($10.35 per year). In essence, the provision of municipal recycling services benefits society by more than the cost of resources required. But others might question the inclusion of such intangible benefits to households in the benefit-cost calculus because households' willingness to pay seems to be based on altruistic preferences. How were households endowed with such preferences? Economists rarely dwell into such issues and instead prefer to accept preferences as given. But critics of municipal recycling programs argue that households may have based such preferences on incomplete information that arose from a perceived national shortage of disposal space.[27] These critics also point to the fact that garbage disposal space has nearly doubled over the past decade, and household preferences could change once they become aware of this fact. Hence, the intangible benefits to recycling households estimated by this study may be short-term phenomena and should not be used to shape environmental policy.

Such debates should probably remain with policymakers. The point of this study is to explain the trend in recycling, not justify or criticize it. And although the intangible benefits to households may be questionable to critics of recycling, they are quite real to the elected officials of the local government contemplating the implementation of a recycling program. Residents have demanded municipal recycling services, and governments seem to have responded.

Of course, municipal recycling could still pass an overall benefit-cost criterion even if the nonmarket benefits to households measured above are excluded from the analysis. Households located near rural dumping sites and manufacturing centers do face the external costs of garbage disposal. The environment in the vicinity of these households would benefit directly from reductions in garbage brought on by municipal recycling programs. Additional research could determine the value of such benefits. If the value of these more tangible benefits exceeds the direct costs measured here, then curbside recycling could be justified on benefit-cost principles.

Appendix:
The Questionnaire With Mean Responses

Hello. My name is Peter Coughlin. I am a student at Bucknell University. We are doing a survey on how people feel about recycling in Lewisburg. Bucknell University will make a $5 donation to a local charity if you agree to answer a few questions about recycling. The survey should take no longer than 3-4 minutes and your responses will be held confidential. Do you have a few minutes?

IF NO: May I call you back at a more convenient time?

1] Would you prefer the $5 donation be given to

_____	The William Cameron volunteer fire department	[60%]
_____	Lewisburg Evangelical hospital	[23%]
_____	The local chapter of the United Way	[17%]

2] The Borough of Lewisburg collects newspaper, glass, and aluminum cans from your curb on the first Saturday of every month. Would you say you normally participate in this recycling program?

_____Yes	[75%]	(Go to Question 3a)
_____No	[25%]	(Go to Question 3b)

3a] Would you say the main reason you recycle is because it is good for the environment, or because it is your civic duty?

_____	It is good for the environment	[53%]	
_____	It is my civic duty	[13%]	[33% did not answer]

3b] In your opinion, is recycling good for the environment?

_____	Yes	[96%]
_____	No	[4%]

4] Which of the following would you consider the most difficult part of recycling?

_____ It is hard to clean and separate the material	[17%]	
_____ It is hard to find a storage place in your house	[57%]	
_____ It is hard to remember the right day	[18%]	[7% did not answer]

5] As you may know, the Borough of Lewisburg also provides a drop-off facility on 5th Street for you to take your tin cans, plastic bottles, and cardboard boxes. Would you say you normally take some of these materials to 5th Street?

_____ Yes	[54%]
_____ No	[46%]

6] Please think carefully about your answer to this next question. You currently pay $31.35 per quarter for disposal service. If it was found that the municipality needed to increase your quarterly bill by $2, $3, $5, $10, or $20 to NEW VALUE to keep recycling available in Lewisburg, would you be willing to pay it? Or would you prefer the recycling program be abandoned?

	$2	$3	$5	$10	$20
_____ Pay the extra fee	19/20	17/20	18/18	17/22	12/20
_____ Abandon the recycling program	1/20	3/20	0/18	5/22	8/20

7] (Only for people that said YES to Question #2) If curbside recycling were not available in Lewisburg, do you think you would take newspaper, glass, and aluminum to the 5th Street drop-off center?

_____ Yes	[83%]
_____ No	[17%]

Now, I have a few final questions about yourself

8] Do you own or rent your home?

_____ Own	[64%]
_____ Rent	[36%]

9] How many individuals live in your household?_____[2.39]

10] What year were you born in?_____[average age: 52 years]

11] Do you hold a college degree?

_____ Yes	[60%]
_____ No	[40%]

12] Would you say your household income is

_____ Less than $20,000	[19%]	
_____ $20,000-$40,000	[31%]	
_____ More than $40,000	[40%]	[10% did not answer]

Thank you very much for your time spent answering these questions. A $5 donation will be made to the _____. Have a nice evening.

13] Sex of respondent:_____ male[32%]
_____ female[68%]

Notes

1. Subtitle D of the Resource Conservation and Recovery Act (RCRA) of 1976 is partly responsible for the shift to more distant landfills. This law imposed technology-based standards on the construction, operation, and closure of solid waste landfills. Old town dumps were often out of compliance and forced to close (the number of landfills operating in this country decreased rapidly from about 8,000 in 1988 to slightly more than 2,500 in 1997). But the sizes of most newly constructed landfills increased to reduce average costs (based on data reported by Glenn, 1998, the nation's average disposal capacity doubled from just 9 years in 1988 to roughly 20 years in 1997). Land costs and organized NIMBY (not in my backyard) groups near population centers have discouraged these new larger landfills from locating in populated areas.

2. Grants in the amount of $183 million were provided by 34 state governments in 1997 to offset some of the costs of setting up and operating recycling programs (Glenn, 1998).

3. Carroll (1997) used such a cross section of towns in Wisconsin to estimate that it costs between $140 and $240 per ton to recycle. Market benefits are not estimated. Folz (1999) used self-reported survey-based cost data to estimate that recycling costs an average of $85 per ton. Franklin Associates (1994) used data based on national cost averages to simulate the costs of adding a curbside program in a city of 500,000 people. Recycling is estimated to increase solid waste management costs by $9.52 to $16.53 per ton. Finally, Palmer, Sigman, and Walls (1997) did not measure costs directly but used elasticity estimates to conclude that recycling up to a rate of 7.5% of total waste can be beneficial if a deposit-refund policy (the lowest cost policy) is used by the community to encourage recycling. Recycling beyond this threshold is costly.

4. Act 101, passed in July of 1988, requires all communities with populations above 5,000 in Pennsylvania to implement curbside recycling programs. The act also provides grants to offset recycling expenses.

5. Nor do households in Lewisburg face a unit-based pricing program for regular garbage collection.

6. Duggal, Saltzman, and Williams (1991) found that communities that enforce recycling laws with fines experience no more recycling than towns without such enforcement.

7. Industrial waste and recycling is omitted from the analysis. Very little industrial production occurs in Lewisburg. The local government does not manage any industrial waste that is produced.

8. Lansana (1993) found differences in recycling attitudes and behavior between urban and suburban areas.

9. Dubin and Navarro (1988) found that an increase in the population density by 100 persons per square mile decreases the average cost per ton of collected materials by $1.62. Kinnaman and Fullerton (1999) estimated that an increase of 100 persons per square mile increases the likelihood that a community will adopt curbside recycling by 0.39%.

10. The price of recyclable material will provide a biased measure of the marginal benefit of recycling if the extraction of virgin material is federally subsidized. Without a reliable estimate of the cross-price elasticity of demand for recycled materials with respect to a change in the price of virgin material, the effect of this bias cannot be controlled for.

11. An intermediate buyer often provides processing and transportation services for the municipality and, therefore, pays a lower price for the material.

12. Another potential benefit to the municipal government is garbage collection costs attributable to the extra recycling. Data limitations prevent including this benefit in the analysis.

13. Although the municipal recycling program provides local jobs to unskilled laborers, the additional jobs would be considered a benefit only during periods of underemployment. Unfilled job vacancies for unskilled labor have been common in the Lewisburg economy throughout the 1990s. Thus, labor is treated here as a cost of recycling and not a benefit.

14. The glass shredder needs new knives twice per year, a new conveyor belt every 2 years, and a new chute every 3 years.

15. Klein and Robison (1993) studied the impact of garbage costs on commercial recycle behavior.

16. Roberts, Douglas, and Park (1991) used contingent valuation to estimate a willingness to pay $227 per household per year to avoid the siting of a landfill near their community.

17. Little is currently known about the desirability of such state laws. A state law requiring the implementation of recycling programs by all communities could be beneficial if the external benefits of a better environment experienced by all state citizens exceeded the summation of the costs to all municipalities required to recycle. An extensive benefit-cost study would be necessary to estimate the external benefits of recycling to other members of the state or country. With a simplifying assumption, cost data gathered in Lewisburg can be used to provide a point estimate of the total out-of-pocket costs of the state law. Recall that Lewisburg's recycling program cost $18,545.17 to recycle 334.46 tons of material, amounting to $55.44 per ton more than regular disposal. If the cost per ton to recycle in other parts of Pennsylvania is the same as in Lewisburg, the total cost of recycling the additional 1,296,000 tons brought on by the state law is estimated at $71.85 million, or $15.98 per household. If households value the external benefits by more than this value, the state law could be welfare improving. This estimate assumes the cost of disposal and the prices of recyclable materials are not affected by the implementation of the state law requiring municipal recycling programs.

18. Combining nine survey-based studies, DeYoung (1996) found that individuals derive intangible payoffs from engaging in either frugal or conservation activities.

19. Households could instead be endowed with tastes for a clean environment and would recycle if they believe their efforts would improve the overall quality of the environment. But because the number of households in the economy is large, each household has the incentive to free-ride off of the recycling activities of others.

20. One unfortunate weakness of this survey technique is that residents with unlisted phone numbers are systematically excluded from the sample.

21. Of the 177 households telephoned, 19 lines were disconnected and 37 were not home after three attempts. Of the 121 that answered, 21 refused to respond to the survey. The size of the sample was defined primarily to satisfy research budget constraints. A larger sample would have increased the likelihood that the sample was representative of the population.

22. This procedure is an example of a "closed-ended" contingent valuation survey. Other survey methods include an "open-ended" procedure, a "sequential bids" procedure, the "response card" approach, and the "open-ended with follow-up" procedure. The primary advantage to the approach used in this study is that it is easy on the survey respondents (perhaps increasing the response rate) and the pricing scenario mimics an actual market decision (Cameron & Huppert,

1991). A weakness is that the sample size must be very large to capture efficient estimates of the average willingness to pay. The literature is rich with examples of each method. See Cameron and Huppert (1991) for a sample.

23. Households also identified their income and demographic characteristics. As identified in the appendix, 83% of households in the sample were owner occupied, the average household size was 2.39, and the average age was about 52 years. Sixty percent held at least a bachelors degree, 40% earned more than $40,000 per year, and 68% of the respondents were women. Conventional survey wisdom indicates that women are more likely to pick up the phone than are men. Young adults were also more likely to be away from home in the early evening while the survey was taken.

24. A nonparametric procedure developed by Kristrom (1990) was also used to derive a point estimate of the household's average willingness to pay for the recycling program. Using this method, the mean willingness to pay for the municipal recycling program is estimated at $24.83 per quarter, or $99.32 per year.

25. Households that chose to abandon the recycling program in Question 6 (rather than pay the fee) may hold a negative net willingness to pay. The resource cost to recycle to these households could be greater than any utility gained from the program. But these households are only made worse off by the program if they are forced to participate. Although the municipality has passed a mandatory participation ordinance, it is rarely enforced on households. Assume, then, that no households are made worse off by the program.

26. Tiller, Jakus, and Park (in press) apply CVM **(AUTHOR, PLEASE SPELL OUT CVM HERE)** to estimate that a suburban household is willing to pay $11.74 per month for drop-off recycling. Jakus, Tiller, and Park (1996) use surveys and travel-cost data to estimate that a household is willing to pay $5.78 per month ($69.36 per year) on average for the ability to recycle newspaper and glass.

27. This perception may have been the result of the media's elaborate coverage of the garbage barge Mobro's storied attempts to unload (unsuccessfully) garbage along the east coast of the United States in 1987 (Bailey, 1995).

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