How Local Governments Structure Contracts with Private Firms: Economic Theory and Evidence on Solid Waste and Recycling Contracts

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Abstract

Solid waste management services are contracted out to private firms in many U.S. communities. Household waste collection, transport, and disposal are relatively straightforward services to define within the terms of a contract. The addition of recycling, however, significantly complicates matters. How should contracts be structured to provide incentives for recycling? Who should own key facilities, such as recyclable materials processing facilities? Should a separate contract for processing and sale of materials be used, or should these services be provided by government employees or purely private markets? These questions are addressed in this study using the principal-agent framework and the theory of incomplete contracts in economics. I explain stylized facts in the industry, including facts about asset ownership, and look in detail at contracts used in seven communities that have achieved high rates of waste diversion and recycling.

Key Words: incentive contracts, asset specificity, principal-agent models, waste collection, recycling

JEL Classification Numbers: L33, L14, Q2

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I. Introduction

Local governments contract out many public services, ranging from street cleaning and snow plowing to the operation of prisons and jails. Two of the most commonly contracted activities are residential solid waste collection and recycling. In fact, some experts have long considered that of the many services provided by local government, waste collection is a leading candidate for contracting out because it is a relatively straightforward, technologically simple activity and because the cost of service disruption is comparatively low (Bennett and Johnson 1980; Nelson 1997).

Waste management is much less straightforward at the start of the 21st century, however, than it was 30 or even 20 years ago. Then, municipal solid waste management amounted to collecting all the trash that households generated, hauling it to a landfill, and dumping it in. Households paid for the service through property taxes or flat rates on water or sewer bills. But beginning in about the mid-1980s, communities became much more concerned with the volume of waste generated and disposed of, as well as the management of landfills. In addition to federal landfill standards, there now exist targets or goals on recycling or waste diversion (from landfills) at the state level, and several states require local communities to provide recycling services to their residents. The U.S.

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Environmental Protection Agency estimates that there were 9,300 municipal curbside recycling programs in the country in 2000, compared with only 1,000 in 1988.[1]

In a recent study Walls et al. (2003) found that the use of contracts between local government and private waste management firms is widespread for both waste and recycling services. In a 1995 sample of U.S. communities, contracts were used for residential waste collection, curbside collection of recyclables, and recyclables processing in 36%, 40%, and 30% of communities, respectively.[2] The authors estimate a model of a community's choice of service delivery method for both waste and recyclables collection and find that costs—particularly "economies of density" in service provision, transaction costs associated with contracting, and costs associated with state government mandates—are an important factor in local government decisionmaking. Political influence and regulatory "capture" variables, on the other hand, are not significant determinants of communities' waste and recycling choices.

Those results provide some reassurance that local governments take costs into account when making decisions, and that they presumably choose a contract over other options—government provision in particular—when it appears to be the least-cost option. An interesting follow-on question is addressed in this paper: how are contracts between local governments and private waste and recycling firms structured? In particular, how are local governments designing contracts to achieve the multiple objectives of cost minimization, service quality, and attainment of environmental objectives? The study is not a normative one—that is, my point is not to say how contracts *should* be structured. Rather, I call on results from the principal-agent and incomplete contracts literatures in economics to explain stylized facts in the industry.

I begin by describing the principal-agent model and the theory of incomplete contracts, along with its forerunner, transaction cost economics. I then provide some

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[1] In addition to collection of recyclable materials, yard waste collection and composting programs have become common. These were virtually unheard of in 1988, but by 2000, the U.S. environmental Protection Agency estimates, there were 3,800 across the country (U.S. EPA 2002).

[2] The results are based on a 1995 International City/County Management Association (ICMA) survey of 1,071 communities. See Walls et al. (2003) for more details.

summary statistics on ownership of key waste and recycling facilities, such as landfills, waste-to-energy incinerators, transfer stations, composting facilities, and recyclable materials processing facilities. The incomplete contracts literature emphasizes the role of relationship-specific assets; thus it is interesting to look at who owns these different types of assets and what the theory has to say about these patterns of ownership. Seven U.S. communities that have achieved relatively high rates of waste diversion and recycling are then analyzed in greater detail. I look at ownership of waste and recycling facilities in these communities, whether a single firm or separate contractors are used for both waste and recycling, and whether contracts are structured to provide incentives to increase recycling. I also pay attention to how incentives are provided to households: directly by the government or indirectly through the structure of the contract between the government and the private firm managing the materials. One community that has experimented with incentive-based contracts to a greater extent that most other communities—San Jose, California—is analyzed in more detail and compared with other communities.

2. The Principal-Agent Framework and Optimal Contracts[3]

An agency relationship exists when one individual, called the agent, acts on behalf of another, called the principal. Often the principal owns an asset and hires the agent to increase its value. Many examples of principal-agent relationships exist in society: shareholders of a company and the managers who run it; a client and his lawyer; a patient and her doctor; and local government and the contractors it uses to provide government services, such as waste collection.[4] Wherever there are gains from specialization, an agency relationship is likely to arise because of comparative advantage.

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[3] The principal-agent framework was pioneered by Ross (1973), and the literature on the implications of these models and the design of contracts is large and growing. For this discussion, I relied primarily on a review article by Hart and Holmstrom (1987), chapters 6 and 7 of Milgrom and Roberts (1992), and Grossman and Hart (1983).

[4] Local government is actually an agent for the citizens of the community; however, we ignore that added layer here.

The terms of an agency relationship are spelled out by a contract. The contract specifies the payments to be made by the principal to the agent, contingent on the agent's taking certain actions and/or the principal's observing certain outcomes. If the principal can perfectly observe the agent's effort and knows what constitutes an efficient level of effort, then a contract can be written that will lead to a first-best outcome. In reality, however, the agent's level of effort is usually unobservable. Shareholders do not know how hard the managers are working to increase profits; patients cannot be completely sure of the level of effort undertaken by their doctors on their behalf; the government cannot perfectly monitor the effort level of its contractors. These hidden actions, and the fact that all individuals tend to act in their own best interests, can lead to problems of shirking. In most contractual relationships, this "moral hazard" problem prevents attainment of a first-best outcome. However, contracts can be designed to limit the extent of the problem, and in what follows, I discuss the features of second-best optimal contracts.

When effort, or the level of inputs, is unobservable, contracts can base compensation on observable outcomes. In general, if outcomes can be measured with continuous variables, contracts will usually specify payment as simple functions of outcomes, such as linear functions, threshold functions, or some combination of the two. A linear contract takes the following form:

$$(1) \qquad p(x) = \alpha + \beta x$$

where $p(x)$ is the amount paid to the agent, x is the measured outcome, and α and β are chosen constants. The higher the value of β, the stronger the link between the payoff to the agent and the observed performance measure, x. Linear contracts are quite common in practice: commissions paid to sales agents, contingency fees paid to lawyers, "piece rates" paid to factory workers.

A threshold contract takes the following form:

$$(2) \qquad p(x) = \begin{cases} p_0 & if \quad x < x^* \\ p_1 & if \quad x \geq x^* \end{cases}$$

In this case, the agent receives a low payment, p_0, if a performance goal, x^*, is not reached—that value could even be zero—and a high payment, p_1, if the goal is reached. Some contracts combine a threshold with a linear contract for performance above the threshold:

$$(3) \qquad p(x) = \begin{cases} p_0 & if \quad x < x^* \\ \alpha + \beta x & if \quad x \geq x^* \end{cases}$$

If the measured outcome, x, depends on random factors in addition to the agent's level of effort, then paying the agent based on x will mean that the agent is incurring some risk. And the "sharper," or more high-powered, the incentives, the more risk the agent incurs. As long as the agent is risk-neutral, this is not a problem. In fact, if the agent is risk-neutral, she should bear all the risk. In other words, it would be efficient to have a contract of this form:

$$(4) \qquad p(x) = \alpha + x$$

This is a linear contract, but the agent keeps all the residual gains created by her effort (i.e., $\beta=1$). An example of a contract of this type might be a franchise arrangement, whereby the value α is a negative amount equal to the franchise fee. Once the agent has the franchise, she keeps all the returns from her effort—that is, x would be profits and every additional dollar in profits accrues fully to the franchise holder. Another example would be a fixed-price procurement contract in which a contractor is paid a fixed fee α to provide a service, such as waste collection, the costs of which are $-x$. Firms bidding for a collection contract should submit bids based on expected collection costs, so α in equation (4) would cover expected costs. If the firm is able to reduce its costs *ex post,* it would keep any residual gain. These types of compensation arrangements exist in

waste collection and recycling contracts, and we discuss their effects in more detail in Section IV.

In practice, agents may often be risk-averse.[5] To induce an agent to accept a fixed-price contract, or any contract that ties her payoff to an outcome over which she does not have full control, the principal must pay a risk premium. This means that an optimal contract will involve some sharing of the risk between the principal and the agent. Ideally, if incentives were not an issue, risks would be borne by the least risk-averse individual in the transaction. However, the contract needs to provide incentives as well as balance risks. This means that the agent will need to be guaranteed some income regardless of performance but will also need to be provided enough incentive that she does not shirk. The linear contract in equation (1) can do this, and the optimal value of β—that is, the sharpness of the incentives—will depend on four factors:

1. *The agent's degree of risk aversion*. A contract with sharp incentives will be expensive when the agent is highly risk-averse, since a large risk premium would be required. This means that in general, the more risk-averse the agent, the less that compensation should be tied to performance, and the lower the optimal value of β.
2. *The marginal contribution of effort to the measure of performance (and the smaller the role played by random factors)*. If more effort by the agent does not increase performance by very much, or if other factors outside the agent's control play a large role, the optimal value of β is lower.
3. *The precision with which performance is measured.* If the performance measure does a poor job of tracking the outcome that the principal really cares about, then the link between that measure and the agent's pay should not be strong, and β should be lower.

[5] An individual is said to be risk averse if he prefers a sure thing to a gamble of equal expected value. A risk-neutral individual is indifferent between the two outcomes.

4. *The degree to which the agent responds to incentives by increasing effort.* If inducing additional effort from the agent is difficult, an optimal contract has a weaker link between compensation and performance, and β is lower.

The third factor above says that the precision of the performance measure matters for the sharpness of the incentives in the contract. This implies that it might be worthwhile for the principal to invest in resources to improve the precision of those measures. Improving the precision would reduce the risk premium that needs to be paid to get the agent to accept a contract with sharp incentives, and the sharper the incentives, the harder the agent works. One way to improve the precision of performance measures is to increase monitoring of performance. If a community wanted to use a performance contract to encourage recycling, for example, it could tie the contractor's compensation to the volume of materials recycled. It could even use differential compensation by material type. However, to do this accurately, it would need to monitor carefully to ensure that materials are not only *collected* for recycling but are actually processed and sold in secondary markets (and not just taken to the landfill). The government could do this by requiring bills of sale, trucking manifests, and so forth.

Even precise performance measures do not necessarily ensure good outcomes, however. A principal might have a very good measure of one aspect of performance, say a quantity measure, but no measure at all of another aspect of performance, say quality. If the agent's compensation is based only on the first measure, and the two measures are substitutes, then they can be "gamed"—that is, the agent devotes too much time to increasing quantity and not enough to increasing quality. An example would be a payment schedule for picking strawberries that is based on the weight of strawberries picked. Workers have no incentive to take care not to damage the strawberries when picking them. Another example is basing teacher evaluations on the performance of students on standardized tests. This type of contractual arrangement will lead teachers to focus their efforts on one measure of overall teaching performance, the results on the standardized tests (Holmstrom and Milgrom 1991).

In waste and recycling collection, it might be important to ensure that contractors do not litter or damage bins or property as they collect materials, that they show up at scheduled times, and so forth. Another problem in the waste area can arise if a contractor is compensated based on the volume of materials recycled, some of which are more valuable than others. The community might prefer to see the contractor recycle relatively more of the more valuable materials. One way of ensuring that this takes place would be to make the contractor the residual claimant on any revenues received (or losses incurred)

from the processing and sale of materials. That would give him the incentive to collect and recycle the more valuable materials.

The gaming problem feeds back to the need for monitoring. It may be worthwhile for the principal to supplement monitoring of the stated performance outcome with measurement of other "signals" of appropriate effort. For example, teachers are often paid more when they take additional college-level courses because, presumably, these courses enhance their teaching ability. A government waste collection contractor may have its compensation based on a quantity measure, such as number of households served, but it may also have its customer service levels monitored in some way. The government could keep a record of, for example, the number of customer complaints, the time that elapses before customer complaints are addressed, and the severity of complaints. In general, such monitoring can mitigate the incentive that the agent has to neglect dimensions of performance that are not directly tied to remuneration. Furthermore, use of increased information in determining payment can reduce uncertainty and thus lower the risk premium necessary for the agent to accept the contract.

3. The Incomplete Contracts Approach[6]

The principal-agent approach to the study of contracts emphasizes, to a great extent, the role played by risks. If parties to a contract are risk-neutral and if there is no hidden information or actions, according to the theory, a first-best efficient outcome can be reached. However, in reality, there can be situations in which these two conditions hold and yet efficient contracts are still unattainable. The reason is that contracts are often incomplete.

In the literature on incomplete contracts, the reason that two parties decide to have a long-term contractual relationship is generally because of the existence of investments that are, at least to some extent, relationship-specific. In other words, to trade with each

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[6] This summary of the incomplete contracts literature is based on studies by Hart and Moore (1990), Hart et al. (1997), Hart (1995), and Bajari and Tadelis (2001) and on the literature on transaction costs, which is represented by Williamson (1985) and Klein et al. (1978).

other, the parties need to make certain investments, and those investments have a higher value within the relationship than outside it.[7] Once the investments are made, each party has some monopoly power *ex post* even if there was competition *ex ante.* To get around this problem, a contract of some type is necessary. If there are no costs associated with writing, monitoring, and enforcing the contract, then a comprehensive contract can be written that spells out all possible contingencies and what should be done in each case. In a standard principal-agent model, even when the first-best cannot be attained because of hidden actions, an optimal second-best contract will still be *comprehensive* in that it will specify each party's obligation in every possible contingency. But in many situations, writing, monitoring and enforcing contracts are not costless. This fact lies at the heart of the longstanding literature on transaction cost economics (Williamson 1985; Klein et al. 1978). That literature reveals that three important factors are ignored in the principal-agent framework. First, it is difficult for people to think ahead and plan for all contingencies. Second, even if individual plans can be made, parties have difficulty negotiating over these plans. And third, even if planning and negotiating are viable, it may be impossible to write a contract that can be enforced in a court of law. In other words, both parties may have the same information and agree on particular outcomes but those outcomes are not verifiable to a third party. As a result of these factors, contracts will be incomplete.

This would not be such a serious problem if the costs of renegotiating contracts were zero. But they are not; moreover, even if the parties are willing to incur renegotiation costs, if they have asymmetric information at the renegotiation stage, they may not be able to reach an efficient agreement. Even these problems would not be serious if the parties could easily turn to new trading partners at that point. But this brings us back to the importance of sunk costs: investments have been made that have less value outside of the relationship than they have within it, and those investments bind the parties together. The existence of these assets can lead one party in the contract to attempt to hold up the other in negotiations. In fact, when contracts are incomplete, the parties may

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[7] The term investment is used loosely here. Whenever one party is forced to pass up an opportunity as a result of a relationship with another party, an investment—that is, a "sunk cost," either a direct or an opportunity cost—has been made (Hart and Holmstrom 1987).

be deterred from making the relationship-specific investments in the first place. In the transaction cost economics literature, it is this fact that suggests a need for vertical integration—that is, having a single firm perform the functions that, in a world with complete contracting, could be done by two separate firms.

Likewise, transaction costs and incomplete contracts can provide an argument for government provision of a service.[8] For services that are typically arranged by local government, such as waste management, government officials usually choose between using government-owned assets and employees and writing a contract with a private firm.[9] If there are significant transaction costs associated with writing, monitoring, and enforcing a contract, and there are relationship-specific assets necessary for providing the services, the government may choose to own and operate these assets itself. In the case of waste and recycling services, these assets include secondary materials processing facilities, waste transfer stations, incinerators, and landfills. In the next section of the paper, I look at the ownership patterns of these assets in a sample of U.S. communities.

4. Waste and Recycling Contracts in U.S. Communities

4.1 Waste Collection and Ownership of Waste Facilities

In a community without a recycling program, the basic service that a solid waste contractor provides to a local government is collection of all the waste generated by all households in the community on a regular basis, often once a week; transport of that waste to a transfer station, landfill, or waste-to-energy incinerator; and then disposal of the waste at that location.[10] Collection is a relatively straightforward service that is easy

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[8] See Hart et al. (1997) for more on this and an application to management of prisons. See also Shleifer (1998) for a general discussion of private versus government ownership and Domberger and Jensen (1997) for a survey of government contracting in the context of incomplete contracts.

[9] In some communities, for collection services, local government simply licenses private firms to operate in the jurisdiction. However, this arrangement is less common than contracts and government provision.

[10] Waste transfer stations are large buildings or outdoor areas where waste is stored temporarily before being consolidated for shipping by truck or rail to a landfill or incinerator, often outside the community. Waste-to-energy incinerators burn waste to generate electricity; they are not common in the United States. Most waste is ultimately disposed of in landfills.

to define within the terms of a contract. Moreover, monitoring and enforcement is comparatively inexpensive for the government because households themselves, in effect, do much of the monitoring. The contract may include some other aspects of performance, such as minimal littering and truck noise, but again, community residents help monitor. Capital assets used in provision of the service, such as collection vehicles, can be moved relatively easily to a new location. This means that they are not relationship-specific and thus not a potential source of contractual holdup. Therefore, waste collection contracts should be relatively complete. And in the absence of recycling, issues of risk should be minimal. The extent of "economies of density" are the determining factor in costs—that is, the costs of providing the service tend to fall as population density rises, and thus, knowing the number of households and the geographic area to be served takes most of the uncertainty out of costs.[11]

Once waste is collected, it must be legally disposed of. There are essentially three possibilities: (1) the collection contract can simply specify that waste be legally disposed of, leaving the contractor to find a landfill to accept the waste, either in a spot market transaction, through a separate contractual arrangement, or in its own facility; (2) the government can own a landfill (or other disposal facility) and require the collection contractor to dispose of waste in that facility; or (3) the government can have a separate disposal contract with a private landfill or other facility and require the collection contractor to deliver the waste to that facility. Because disposal facilities represent a fairly sizable capital investment and because, in some cases, they can be relationship-specific, contractual incompleteness can be a problem for waste disposal. The 1995 International City/County Management Association (ICMA) survey of 1,071 U.S. communities asked about market organization of waste transfer stations, incinerators, and landfills, and Table 1 reports some results. The table shows, for the communities that report having facilities within their jurisdictions, the percentages that are owned and

[11] Several empirical studies find that collection costs exhibit so-called economies of density. See the findings and corresponding discussion in Dubin and Navarro (1988).

operated by government, organized through a contract with a private firm or sole source franchise, and owned by private firms without a government contract.[12]

Interestingly, and perhaps not surprisingly, most of the communities that report having these facilities also report government ownership of them. Between 61% and 63% of transfer stations and incinerators and 56% of landfills are government owned.[13] In recent years, there has been a trend toward large, privately owned regional landfills that accept waste from many areas, including, in some cases, waste transported from long distances (Ley et al. 2002). Landfills thus may be less relationship-specific than transfer stations and incinerators. This could explain why government ownership of landfills is lower than for the other two types of facilities. Incinerators have unique features that can present problems in contractual relationships. They are costly to build and operate and thus need a reliable supply of waste feedstock to generate revenues from electricity sales to offset those costs. Walls et al. (2003) found that government provision of waste collection services is more likely in communities where the government has owned an incinerator for five or more years than in communities without such facilities.

4.2 Recycling and Ownership of Recycling Facilities

When a community is concerned with reducing the volume of waste in addition to providing collection and disposal services, the question of how to structure contracts becomes more complicated. Steuteville (1995) reports that all but seven states set waste diversion or recycling mandates in 1995. In these cases, local government is faced with how best to structure contracts to spur recycling in a cost-effective manner.

Several factors come into play. First, with simple waste collection contracts, households essentially need do nothing except put their trash in a proper receptacle and place it in the right location for collection. Since they have an individual incentive to do

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[12] Transfer stations exist in 43% of the communities in the ICMA survey, incinerators in 21%, and landfills in 68%.

[13] We include as "government" ownership by the local government responding to the survey as well as intergovernmental agreements (IGAs) among different branches of government. The latter are quite common for these facilities:Thirty-three percent of transfer stations, 57% of incinerators, and 35% of landfills are arranged by an IGA. In most cases, IGAs are between city and county branches of government.

this—they want their trash taken away—the contractor need not worry, for the most part, about the households' doing the right thing. When waste diversion is an additional objective, however, it is necessary to induce households to recycle. Exactly how to do that within the structure of a contractual arrangement between the government and a private firm is a difficult issue. Should the government provide incentives directly to households, or should it structure the contract so that the contractor provides the incentives?

Second, issues of risk are likely to be much more important when there is recycling. In part, this issue is related to the first one: if households do not reduce waste and the contract states that the contractor must meet the diversion target, then the contractor pays the penalty when the target is not met. It cannot directly control how much waste individual households generate or how much recycling they do. In addition, it may incur a risk after collection if it is fully responsible for processing and selling the recyclable materials collected. If the contractor is the residual claimant, it bears all the price risk. Secondary materials prices are notoriously volatile; thus this risk could be significant.

Third, ownership of yet another fixed asset enters the picture. The collected materials must be processed, and the facilities necessary to do such processing—typically referred to as materials recovery facilities, or MRFs—are generally large and costly. As with the options for waste disposal, the government can handle processing of recyclables in several ways: (1) the collection contractor can own and operate the MRF; (2) the government can own and operate the MRF and require the contractor to bring the collected materials to the government facility[14]; (3) the government can have a separate contract with a processor and require the collection contractor to deliver materials to the facility under contract; or (4) processing and sale of materials can be left to private markets—a third party that handles processing either through a separate contractual arrangement with whoever collects the materials or through spot market transactions. Some materials have had a long history of profitable private-market recycling—aluminum, some other metals, newspaper, and corrugated cardboard, for example—and

[14] It might also be possible for the government to own the MRF but have a private contractor operate it.

thus relying on spot markets may be feasible in some locations. In addition to MRFs, composting facilities are necessary if yard waste is to be diverted from landfills. These facilities require a smaller capital investment than MRFs; nonetheless, the question of who should own and operate them remains.

The ICMA survey asks communities the same questions about their composting facilities as it asks about waste facilities. More than 64% of communities that report having a composting facility say it is government owned and operated. Only 24% report having a contract or franchise arrangement, and 11% rely on private markets. Thus, government ownership is even more common for composting facilities than it is for the waste facilities listed in Table 1.

Unfortunately, the ICMA survey did not ask exactly the same question about MRFs that it asked about landfills, transfer stations, incinerators, and composting facilities. Nonetheless, it did ask communities what arrangements they make for provision of particular waste and recycling services, including processing of recyclables. Table 2 reports results from the survey.

If communities report that government employees are processing materials, it should mean that the government owns a processing facility. Therefore, according to Table 2, 30.4% of the communities with residential recycling programs own an MRF to process the collected materials or have an agreement with another government that owns one. The remaining communities, approximately 69.5% of the ICMA sample, use private markets—either via a contract or franchise or through spot market transactions.

It is interesting that, in contrast to the waste facilities listed in Table 1, the government appears less involved in operating recycling facilities. Between 56% and 63% of waste facilities, compared with only 30.4% of recycling facilities, are government owned. This could be the case for several reasons. Many municipal recycling programs are relatively new, whereas private recycling of some materials has been around for quite some time. Industrial scrap has been recycled for decades, as have, in some parts of the country, selected postconsumer materials—newspaper, cardboard, and aluminum cans, for example. Thus, in many cases, private processing facilities may have already been in place when the municipal collection of recyclables began. Instead of building their own facilities, which they may have been reluctant to do in any case, given the complicated nature of the enterprise relative to waste disposal, many communities may have chosen instead to rely on existing private facilities. Even if there were no existing local facilities, many communities may have been reluctant to take on the difficult job of processing

multiple types of materials and finding markets for those materials. This reluctance was probably exacerbated by the fact that a significant sunk cost would have to be incurred.

Walls et al. (2003) found that communities are more likely to have government collection of recyclable materials if the local government has owned an MRF for five or more years. This result indicates that these sunk costs affect decisions about the method of service provision. Contracts are likely to be incomplete; thus if the government owns the recycling facility, it may need to vertically integrate into collection of the materials.

4.3 Waste and Recycling Contracts in Seven U.S. Cities

In this section I describe the specific contractual arrangements of a set of U.S. communities identified in a recent study by the Institute for Local Self-Reliance (ILSR 1999) as successful in achieving high rates of recycling and waste diversion: Ann Arbor, Michigan; Bellevue, Washington; Fitchburg, Wisconsin; Portland, Oregon; St. Paul; San Jose, California; and Seattle. Although they may not be typical of all communities, they are likely to be representative of communities that are trying to achieve the multiple objectives laid out above: low-cost waste collection services and attainment of recycling and/or waste diversion goals. This paper is focusing on the design of contracts; six of the seven cities included here use contracts to manage their waste, their recyclables, or both. Only Portland relies on franchises, which are similar to contracts; thus we include it in our sample. All the communities except St. Paul competitively bid their contracts.

I focus on the following features of the contracts:

- Is there a single contract for collection of both trash and recyclable materials, or are there two separate contracts?
- Does the collection contract specify exactly where the waste and the recyclable materials must go after they are collected?
- What is the term of the contract?
- Who owns and operates the waste facilities and the recycling facilities?
- Is the contract for disposal and/or processing of recyclables separate from the collection contract?
- Does the contract provide financial incentives that encourage the contractor to increase recycling?
- Who keeps the revenues from sale of secondary materials?

- Is the contractor required to collect a specific list of recyclable materials from households, or does the contractor have some discretion over what is collected?
- Is the pricing of trash collection "pay-as-you-throw" (PAYT)—that is, do households pay a price per bag, per container, or per pound rather than a flat fee that does not vary with the volume collected?
- Is yard waste collected separately?

There could be many other important features of the contracts; the questions above highlight the issues of risk, performance incentives, asset specificity, and contract incompleteness discussed in the previous two sections of the paper. It is of particular interest to see how the multiple objectives—low-cost provision of services along with attainment of recycling goals—are addressed. Do the contracts contain financial incentives for the contractor to increase recycling? Is the contractor free to determine how best to deal with households or does the government dictate specific requirements?

Table 3 summarizes the findings. Five of the seven communities use a single contract to cover collection of waste and recyclables rather than having separate firms provide the two services. There are likely to be economies of scope in providing collection services, so it makes sense that a single contractor is used in most communities. Ann Arbor and St. Paul, the two communities that have separate contracts for collection of recyclables, both have long histories of doing business with the nonprofit firms that hold the recycling contracts. Moreover, neither uses a contract to manage waste collection: Ann Arbor has government provision, and St. Paul, a private market.

Once the contractor collects the materials, some communities specify a delivery location for the materials. Communities that own waste transfer stations, have an arrangement with a county-owned transfer station, or have a contract with a landfill all require that waste be delivered to that specific waste facility. Bellevue, Portland, Seattle, and San Jose fall into this category. Fitchburg relies on private markets for waste disposal, simply requiring the collection contractor to ensure that waste is legally disposed of. St. Paul does not require the private waste collection firms that operate in the city to deliver waste to any particular facility. The city has run into problems in the past with this arrangement, however, because it owns a facility that makes refuse-derived fuel (RDF) that is used in power plants, and the facility needs a reliable supply of waste feedstock to operate cost-effectively. Without a contractual obligation to deliver the waste to that facility, the collection contractors are free to shop around for a lower tipping

fee, and in the past, they have done so. Four of the communities—Bellevue, Fitchburg, Portland, and St. Paul—do not require recyclable materials be delivered to any specific processing facility. With the exception of Fitchburg, these communities rely on private processors. The Seattle and San Jose collection contracts cover recyclables processing as well; thus, in those two cities, the recyclable materials go to the contracted firm's facility.[15]

None of the communities have separate processing contracts except Ann Arbor, where a city-owned MRF is operated by a contractor. In the other communities, processing is managed as part of the collection contract (Seattle and San Jose) or through separate arrangements made between the collection contractor and a private, third-party processor (Bellevue, Fitchburg, Portland, and St. Paul).[16]

Government-owned transfer stations are common, but landfills and recycling facilities are privately owned and operated in five of the seven communities. Only Bellevue uses a government-owned landfill (owned by King County, where Bellevue is located), and St. Paul has a government-owned RDF plant. Ann Arbor and Fitchburg are the only communities in the sample that have government-owned recycling facilities, and Ann Arbor's facility is operated by a private firm under contract to the city.

The patterns of asset ownership and market arrangements in these communities seem to follow the patterns in the ICMA sample of communities that we discussed above. Waste disposal either takes place in a government-owned facility or is managed via a contract with a private firm, but recycling facilities are generally privately owned and operated. Moreover, it is not unusual for a contractor handling collection of recyclables to arrange for processing services with a private, third-party recycler; the government often takes a hands-off approach to processing. In contrast, contractors handling waste

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[15] In Seattle, there are two collection contractors covering different parts of the city. One of those contractors handles the processing of recyclables as well, and the other is required to deliver its materials to that processing facility.

[16] The county in which Fitchburg is located owns a processing facility, and currently, the recyclable materials are delivered to that facility. However, there is no contractual obligation for the firm handling collection to do that.

collection often are required by the government to dispose of that waste at a particular facility.

In virtually all the communities, the government specifies how the contractor provides service to the households. The government states in the contract exactly which materials must be accepted for recycling; it mandates that yard waste be collected and managed separately; and it uses PAYT pricing.[17] It also often specifies what waste disposal facilities and, in three of the communities, what recyclables processing facilities the contractor must use. Thus, contractors are not given much freedom to decide how recycling and waste diversion goals should be met. Instead, the government bypasses the contractor and makes decisions directly about how to deal with households and also dictates certain service requirements that the contractor must meet.

If the contractor has little choice in what materials he collects, how he collects them, and what he does with them after he collects them, we can expect that incentive contracts would include payment of a substantial risk premium. Perhaps for this reason, with the exception of St. Paul and San Jose, local governments are not using direct recycling incentive payments in their contracts. And St. Paul's payment is small—only $0.50 per ton of material recycled. In 1996, only $10,600 was paid to the contractor in the form of an incentive payment; in that same year, total recycling costs were reportedly $2.5 million (ILSR 1998).[18] San Jose's incentive payment is a threshold payment: the contractor receives a bonus if the recycling rate reaches 40% or above. It also pays a penalty if the rate drops below 35%. San Jose previously used a contract that paid per ton of material recycled but switched to this threshold system in mid-2002. I describe the previous contract in more detail below.

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[17] There are many other service requirements in waste and recycling contracts—such as once-a-week pickup, same-day collection of waste and recyclables, requirements on wages paid to workers, truck inspections and licensing, and many others. Since this paper is focusing on the addition of recycling and waste diversion requirements to traditional waste management, I focus on features of the contracts that are linked with these requirements.

[18] Total recycling costs are reported in ILSR (1998) along with total amount of materials recycled, 21,220 tons. The $10,600 figure was obtained by multiplying $0.50 by 21,220.

Incentives can also be provided through the sale of secondary materials. Interestingly, the degree to which the contractor is the residual claimant on any of these revenues varies widely across the communities. In Seattle, none of the revenues go to the contractor; in three of the communities the contractor gets all the revenues; in the remaining three communities, the revenues are shared between the government and the contractor. In theory, the greater the share of revenues going to the contractor, the more incentive he has to increase both the volume of material recycled and the value of those materials. For example, he might increase efforts to collect relatively more of some materials (say, aluminum cans) from households and relatively less of others (certain plastics). He might also search for a processor that pays a higher price for the materials. On the other hand, the greater the share of revenues the contractor keeps, the greater the risk he faces. This may mean that the government has to pay a significant risk premium in contracts where the firm is the residual claimant. And again, with the lack of flexibility in service provision that these contracts allow, the risk premium could be especially high.

The contractor compensation schemes for the seven cities can be represented in general mathematical terms by the following equation, a variant of equation (2) above:

$$(5) \qquad p(x) = \alpha - \phi c + \beta x + \gamma R(x)$$

where *p(x)* is total compensation; α is the fixed payment from the government (which is likely to be based on the number of households served); *c* is total collection costs; ϕ is the share of collection costs borne by the contractor ($1-\phi$ is the share borne by the government); β is the recycling incentive payment made by the government per ton of material recycled; *x* is tons of material recycled; *R(x)* is net revenues from sale of materials; and γ is the share of revenues from sale of materials that the contractor keeps.

Any reduction or increase in collection costs that occurs after the contract has been awarded and service has begun is borne by the contractor, not the government—in other words, ϕ is equal to one for all of these contracts. This feature of waste and recyclables collection contracts appears to be common across most U.S. communities that use contracts—that is, the use of "cost-plus" elements is rare.

The other parameters in equation (5) vary across the seven communities. Table 4 shows the form that equation (5) takes for each. Ann Arbor, St. Paul, and San Jose have thresholds in their contracts. In Ann Arbor and St. Paul, the contractor keeps all revenues

from sale of materials unless revenues rise to a certain level, in which case the revenues are shared between the contractor and the government. In San Jose, rewards and penalties apply if the recycling rate goes above or below particular levels (in the table, the variable M represents total materials: all waste plus recycling). The parameter Ω in the table is the total financial penalty the contractor in San Jose pays if the recycling rate falls below 35%; Π is the financial reward if the rate goes above 40%. Bellevue, Fitchburg, Portland, and Seattle all have simpler payment schemes, but it can be seen from the table that the extent to which the contractor keeps revenues—that is, the parameter γ in equation (5)—varies widely across the communities, as explained above and shown in Table 3.

Table 4 makes it clear that Bellevue and Portland use fixed-price (FP) contracts, in which all costs are borne by the contractor (or franchisee, in the case of Portland) and all revenues from secondary material sales are earned by the contractor (or franchisee). The same is essentially true for San Jose unless the recycling rate for single-family dwellings drops below 35% or rises above 40%; the contract has been in place only a year, but according to Ryan (2001a; 2001b), these outcomes are unlikely. In these contractual arrangements, the contractor has a strong incentive to exert effort to reduce collection and processing costs and find the best price for secondary materials. However, the contractor bears all the risk of secondary materials price swings; thus a risk premium is likely to be paid to the firms in these cities. Bajari and Tadelis (2001) also point out that FP contracts of this type may lead to higher renegotiation costs if things do not turn out as expected, thus FP contracts are preferred over "cost-plus" (C+) contracts only in cases where the reduced likelihood of renegotiation merits the additional *ex ante* costs of fully specifying performance.[19] Banerjee and Duflo (2000) argue that FP contracts are preferred when the reputation of the contractor is more suspect; the more reputable the contractor, the more likely are C+ contracts.[20] Either of these factors may come into play

[19] Bajari and Tadelis (2001) focus on construction contracts, which are typically either C+ or FP in nature. Their view is that buyers and sellers are always trying to balance the tension between the *ex ante* costs of more fully specifying project design and the *ex post* costs of renegotiating a contract when the initial design is incomplete.

[20] The Banerjee and Duflo (2000) study focuses on the role of reputation in explaining the structure of contracts between software development firms and their clients.

here. In Seattle, the risk of secondary materials price swings is borne by the government; the contractor earns none of the revenues. Seattle is the only city in the sample for which this is the case.

Ann Arbor's and St. Paul's threshold contracts have somewhat perverse incentives. The contractor incurs all the risk (and keeps all the rewards) when revenues are low but must share with the government when revenues are high. The contract thus encourages the contractor to exert effort to increase the amount of recycling and find the best price for secondary materials only up to the point at which the government starts to share in the revenues. Moreover, significant downside price risk is incurred by the contractor.

As mentioned above, between 1993 and 2002, San Jose used a compensation mechanism in which each of its contractors (there were two, serving different geographical areas) received a base payment, set as a flat dollar amount per household, and a recycling incentive payment per ton of material recycled. The contracts were competitively bid, and in their bids, companies specified the incentive payment amounts, as well as the base payments. As in the current San Jose contracts, the two contractors during 1993–2002 were required to do their own processing and kept 100% of residual revenues from the sale of secondary materials.

San Jose's contractual arrangements, both the current threshold contracts and the previous arrangements, are unique among U.S. communities in the degree to which compensation is tied to recycling performance. For this reason, it is useful to look carefully at the accomplishments of the San Jose system. ILSR reports that San Jose's overall recycling and waste diversion rates in 1996 were 20% and 47%, respectively.[21] The 20% figure is at the low end of recycling rates reported by ILSR for the seven communities, but it is difficult to compare recycling rates across communities. Many factors outside the contractor's control affect these rates, such as population density, the relative numbers of apartment units and single-family homes, and possibly factors such

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[21] This 47% figure includes yard waste diversion and covers all residential waste, recycling, and yard waste for both multifamily and single-family dwellings. Recycling rates from multifamily dwellings are much lower than those from single-family dwellings.

as household income and education levels (Kinnaman and Fullerton 2001). Ryan (2001a; 2001b) reports, however, that the recycling rates in San Jose—where the single-family dwelling rate stood at 34% in 2001—had stayed the same for a number of years prior to adoption of the new threshold contracts. The new contracts were designed, in part, as a way to spur the contractors to achieve slightly higher rates (the target in the new contracts is 35%). Two cities of similar size, climate, and population density are Portland and Seattle, and the ILSR study reports that both had higher recycling rates in 1996 than San Jose. Portland's rate was 23%, and Seattle's, 29%.[22]

Comparing costs across cities equally problematic, but again, a comparison with Seattle and Portland may be reasonable. The ILSR study calculated waste diversion costs and waste disposal costs in each city. Diversion costs include costs of collecting and processing recyclable materials net of any revenues received, and disposal costs include costs of collecting waste, transporting it to a disposal facility, and the tipping fee paid for disposal.[23] Table 5 shows the numbers for the three cities, along with an adjusted number for San Jose. ILSR attributed all the recycling incentive payment in San Jose to waste diversion costs and none of it to waste disposal costs, yet Ryan (2001a) reports that the incentive payment covered approximately 20% to 25% of the contractors' total costs of collecting both material streams. The adjusted costs shown in the table take this into account by apportioning 20% of the recycling incentive payment to waste disposal and 80% to waste diversion.

San Jose's waste diversion costs—even with the adjustment—are significantly higher than those of the other two cities, as well as higher than its disposal costs. This fact seems to be primarily a result of the disproportionately high recycling incentive payment made to one of its contractors—more than four times higher than the payment

[22] Portland's waste diversion rate (recycling and yard waste diversion combined) was 40%, and Seattle's, 49% in the year of the ILSR study; thus overall waste diversion in San Jose compares favorably with these two cities.

[23] When collection costs are available only for waste and recyclables together, ILSR apportions costs based on tons collected. Administrative costs are included to the extent that ILSR had information on them.

made to the other contractor.[24] In 1997, Waste Management received a base payment of $6.64/household/month for single-family dwellings and an incentive payment of $65/ton of material recycled, while the other contractor, a local company called Green Team, received $5/household/month plus $280/ton of material recycled.[25] If Green Team's incentive payment had been $65/ton rather than $280/ton, San Jose's waste diversion costs would have been reduced to $71/household/year. This figure is in line with waste diversion costs in Portland.[26]

Even adjusting the San Jose figures does not make the city look like a great success story in comparison with similar communities that do not use incentive-based contracts. The problem may be that at the same time that financial incentives are used to spur more recycling in San Jose, the contract imposes very specific requirements on the contractors. The long and detailed list of materials that must be collected includes some materials that are not collected in many communities, such as textiles, copper wire, aseptic packaging, and used oil and filters. The collection contractor is also required to process the materials and is the residual claimant on all revenues earned. This means the contractor bears all the risk from secondary materials price swings at the same time that it has to collect and process some rather unusual materials. These factors all tend to increase the risk premium and the overall cost of providing the service. As explained in the section above on the principal-agent framework, when the marginal contribution of

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[24] In addition, San Jose's disposal costs are relatively low, in part because the city pays a low tipping fee at the local landfill.

[25] Multifamily payments are slightly different.

[26] This calculation does not take into account the fact that Green Team's per-household payment of $5 is slightly less than Waste Management's, $6.64. On the other hand, I made no adjustments to Green Team's multifamily recycling incentive payment, which according to ILSR was $100/ton in fiscal 1997, still much greater than Waste Management's incentive payment. Interestingly, in the new round of competitive bidding, Waste Management lost its San Jose contract while Green Team retained its contract. Another company, Norcal, won the bid for multifamily dwellings. Also of interest is the fact that, in the new contract, Green Team's reward payment for doing better that the threshold for single-family dwellings is $2.16/service unit/year while Norcal's reward for reaching the higher multifamily target is only $1.00/service unit/year. Thus again, Green Team is earning a much higher recycling incentive payment than the other contractor. The contracts in San Jose have always been competitively bid, but without having further information about the decision process and other features of the individual company's bids, it is unclear why particular companies have been selected.

the agent's effort to the measure of performance is relatively low, the incentives provided in the contract should not be too sharp. The city of San Jose appears not to have borne this in mind in the design of its contracts. Indeed, most of the cities in the sample are very specific about what materials are collected and how they are collected. In such a situation, incentive contracts may not provide much motivation for additional recycling.

It is interesting that PAYT is used in San Jose and in most of the other communities in Table 3. Although this type of pricing is becoming more common across the United States, only 20% of households in 2002 paid for trash collection in this way (Skumatz 2002); the remainder paid a flat fee through property taxes, water and sewer bills, and the like.[27] It is not a coincidence that communities with high waste diversion and recycling rates use PAYT, mandate yard waste separation, and have long lists of materials that households are permitted to put in the recycling bins.[28] But it would be interesting to know how a firm with a more flexible contractual arrangement, along with a financial incentive to recycle, would choose to motivate households to recycle and divert waste from landfills. Furthermore, it would be interesting to see what recycling rates could be achieved under such an approach and at what cost.

V. Conclusions

The principal-agent framework and the literature in economics on incomplete contracts help shed light on local government contracting practices. The principal-agent approach emphasizes the role of risks. Optimal contracts must balance risks, on the one hand, and provide incentives, on the other. The theory of incomplete contracts emphasizes the importance of relationship-specific assets and the extent to which ownership of such assets allows one party in the agreement to exert leverage over the other party. Contracts must balance the up-front costs of writing a more complete

[27] In most communities with contracts, the government takes responsibility for billing households and then pays the contractor. This is true for Ann Arbor, Bellevue, Fitchburg, San Jose, and Seattle. In Portland and St. Paul, private firms bill households directly, and the firms are required to use PAYT.

[28] In Seattle, the contractor is required to offer households five sizes of trash containers.

contract with the costs of renegotiation should the contract fail. Incomplete contracts can also provide a rationale for government provision of services.

In this paper, I analyzed solid waste and recycling contracts in the context of these two strands of the economics literature. In the absence of recycling, solid waste collection and disposal are relatively straightforward services over which to write a contract. Risk issues are minimal, and the only assets that are likely to be relationship-specific are waste-to-energy incinerators, facilities that are not common in the United States. Service quality is not difficult to define, and households themselves act as quality monitors. Reflecting the uncomplicated nature of the enterprise, waste collection and disposal contracts tend to be simple and fixed-price in nature.

Adding recycling increases the risk associated with fixed-price arrangements and brings up additional issues of asset specificity and contractual incompleteness. Risk is higher for two reasons. First, the contractor must find a way to get households to separate recyclable materials from trash; this is not an issue with trash collection, since households obviously want to have their trash hauled away and disposed of. Moreover, the contractor would like to collect more of the relatively valuable materials (say, aluminum) and less of the less valuable ones (most plastics, for example). Second, recyclable materials must be processed and sold in secondary markets, which subjects the contractor to the risk of secondary materials price swings. Finally, materials processing facilities can be costly to build and operate, meaning that significant sunk costs must be incurred either by the local government itself or by private markets. The government needs to balance the risk that comes from relying on private markets against the risk associated with undertaking the investment itself.

The most recent information on ownership of waste and recycling assets, a 1995 survey by the International City/County Management Association, shows that incinerators, waste transfer stations, and composting facilities are government-owned in 61% to 64% of communities. Thus communities are showing a preference for owning these assets rather than attempting to contract with private firms to provide the services. Government ownership of landfills is slightly less common: 56% of communities in the ICMA sample reported that landfills they used were government-owned. Recycling facilities are mostly private: only about 30% of the communities in the ICMA survey reported that they handled recyclable material processing using government employees. Recyclables processing is a more complicated enterprise for local government than waste collection and disposal. Many communities use contracts for collection of recyclables but leave the processing to private markets, simply requiring that the collection contractor

ensure that the materials are handled properly. By contrast, waste collection contracts often require the contractor to deliver the waste to a particular—often government-owned—facility.

In addition to the ICMA survey, I examined in greater detail seven communities identified as having successful waste diversion and recycling programs (ILSR 1996). With respect to asset ownership and the extent to which they rely on private markets, these seven communities mostly follow the national trends that showed up in the ICMA survey. Landfills and recycling facilities tend to be privately owned, but waste transfer stations are government owned. In terms of the types of contracts used, the communities tend to eschew the use of financial incentives for recycling in favor of mandatory recycling requirements. For example, in all seven communities, the government has a long list of recyclable materials that must be collected, stipulates "pay-as-you-throw" pricing of waste collection, and requires that yard waste be collected separately and composted. Thus, the communities have decided that the best way to achieve waste diversion and recycling targets is to incur the costs of fully specifying performance *ex ante.* They say exactly which materials must be separated and collected from households and the prices charged to households. This leaves very little flexibility for the contractor. Probably as a result, recycling incentives are not used in most of these communities. Contracts are fixed-price, and thus contractors have an incentive to reduce costs in order to increase their profits, but there is no direct financial incentive to recycle more. The degree to which the contractors are the residual claimants on any revenues from secondary materials sales differs across the communities. This is, in fact, the one feature of the contracts that varies a great deal.

The one community that does rely on incentive contracts is San Jose, California. I analyzed the San Jose case in some detail and found that the city does not seem to be performing any better than two other western cities in the sample, Portland and Seattle. The latter do not use recycling incentive contracts and yet have higher recycling rates and lower costs. Because the contractors in San Jose have to meet a very specific set of requirements laid out in the terms of the contract, I concluded that there seems little point in providing incentives for additional recycling since there is almost no way for the contractors to respond to the incentives. The incentive contract may be serving only to increase the risk premium the city pays to its contractors. Further evidence of this is the fact that the San Jose contractors are required to process secondary materials themselves and are the residual claimants on all revenues from sale of these materials. The materials recycled include unusual (and costly) items, such as used oil and filters, textiles, and

copper wire. The contractor is thus subject to a significant amount of risk in secondary materials markets. It would be very interesting to see a community such as San Jose experiment with a contract that allows the firm some flexibility at the same time that it provides financial incentives.

This study contributes to the empirical economics literature on contracts that includes studies such as Bajari and Tadelis (2001), Domberger and Jensen (1997), and Banerjee and Duflo (2000). The structure of waste and recycling contracts and the patterns of asset ownership in the industry can be explained by elements of the literature on principal-agent models and particularly the literature on incomplete contracts. Further study of contract structure and waste diversion and recycling accomplishments in communities beyond the seven "successful" communities identified here would be an interesting extension.

Table 1. Market Arrangements for Waste Facilities in U.S. Communities

	Percentage of communities with each option among communities that have such facilities		
	Government[1]	*Contract or franchise*	*Private market*
Waste transfer stations	61.2	32.8	6.1
Waste-to-energy incinerators	62.7	26.3	10.9
Landfills	56.2	32.4	11.4

[1]Including intergovernment agreements, usually between cities and counties.

Note: numbers may not sum to 100 due to rounding.

Source: International City/County Management Association Solid Waste Collection and Disposal Survey, 1995 (Washington, DC: ICMA).

Table 2. Market Organization of Recyclable Materials Processing Services in U.S. Communities

	Percentage of communities with each option among communities that have recycling programs
Government employees[1]	30.4
Contract or franchise	47.5
Private markets	22.0

[1]Government includes local government provision (12.2% of communities) and intergovernmental agreements (18.2% of communities).

Source: International City/County Management Association Solid Waste Collection and Disposal Survey, 1995 (Washington, DC: ICMA).

Table 3. Features of Solid Waste and Recycling Contracts in Selected U.S. Cities[1]

	Ann Arbor, MI	*Bellevue, WA*	*Fitchburg, WI*	*Portland, OR*	*St. Paul, MN*	*Seattle, WA*	*San Jose, CA*
Collection							
Does waste collection contract also cover recyclables collection?	No; govt waste collection; contract for recyclables with non-profit	Yes	Yes	Yes[2]	No; Private waste collection market; contract for recyclables with non-profit	Yes	Yes
Does collection contract specify where waste must go after being collected?	NA[3]	Yes, to county-owned transfer stations	No	Yes, to city-owned transfer stations	No	Yes, to city-owned transfer station	Yes, to landfill that has contract with city
Does collection contract specify where recyclables must go after being collected?	Yes, to city MRF	No	No, but they go to county MRF	No	No	Yes[4]	Yes[5]
Contract length	3 years	10 years	3 years	10 years	12 years	7 years	5 years
Waste Disposal							
Who owns & operates waste facilities?	City owned, privately operated transfer station; Private landfill	County-owned transfer stations and regional landfill	Private	City-owned transfer stations; private landfill	County resource recovery facility (makes refuse derived fuel for power plants)	City-owned transfer stations; private landfill	Private landfill
Is there a disposal contract, separate from collection contract?	Yes[6]	NA[7]	No	Yes[6]	NA[7]	Yes[6]	Yes

Recyclables processing							
Who owns & operates recycling facilities?	City owned, privately operated	Private	County	Private	Private	Private	Private
Is there a processing contract, separate from collection contract?	Yes	No	No	No	No	No[4]	No[5]
Incentive Features of Contracts							
Are recycling incentive payments used?	No	No	No	No	Yes; $0.50/ton collected	No	Yes; penalty for below 35% waste diversion rate/reward for above 40%[8]
How much of the revenues from sale of materials does the contractor keep?	First $45/ton + 65% of remaining revenues	100%	20%	100%	First $50/ton + 50% of remaining revenues	0%	100%
Other features							
Is PAYT used?[9]	No	Yes	Yes	Yes	Yes	Yes	Yes
Is a list of recyclables specified in the contract?	Yes (20 items)	Yes (11 items)	Yes (16 items)	Yes (20 items)	Yes (10 items)	Yes (17 items)	Yes (24 items)
Is yard waste collected separately?	Yes	Yes	Yes	Yes	No[10]	Yes	Yes

NA = not applicable.

[1] These cities were among those identified in Institute for Local Self-Reliance (1998) as cities with successful recycling programs; all achieve recycling rates between 20 and 40% and waste diversion rates (which include recycling and yard waste diversion) between 40 and 60%.

[2] Portland uses a franchise system with multiple franchisees that are required to collect both waste and recyclables from households.

[3] Since Ann Arbor government employees collect waste, this question is not applicable.

[4] There are two collection contracts in Seattle that specify collection of both waste and recyclables; one of the contracts also covers processing and the other contract requires that collected recyclable materials be delivered to the processing facility of the first contractor.

[5] San Jose's collection contract also requires contractor to process materials, thus there is a single contract covering collection of waste and recyclables and recyclables processing.

[6] Communities that own transfer stations have contracts with private companies to transport waste from the transfer station and dispose of it in a landfill.

[7] Since waste facilities are government-owned in these communities, this question is not applicable.

[8] These are the rates for single-family dwellings; multi-family dwelling recycling rate targets are 25% in 2003, 30% in 2004, and 35% by 2005. San Jose's penalty and reward payments are lump-sum. In 2002, the reward payment for the contractor serving single-family dwellings was set at $2.16 per dwelling unit served; there are additional higher reward payments made when recycling rates reach 42%, 44%, and 46%. The penalty for not reaching the 35% target is called an administrative charge and the amount is unclear. The reward payment for the multi-family dwellings contractor is $1/dwelling unit if a rate 5% above the target is achieved.

[9] With "pay-as-you-throw" pricing of trash collection, residents pay a price per bag or per container of a particular size, rather than a flat fee that does not vary with volume.

[10] Residents can contract with some private haulers to collect yard waste separately for an extra charge.

Sources: See Appendix A.

Table 4. Waste and Recycling Contractor Compensation Schemes in Selected U.S. Cities

City	*Compensation scheme*
Ann Arbor, MI	$P(x) = \alpha - c + R(x)$ if $R(x) \leq 45x$
	$P(x) = \alpha - c + 45x + 0.65(R(x)-45x)$ if $R(x)>45x$
Bellevue, WA	$P(x) = \alpha - c + R(x)$
Fitchburg, WI	$P(x) = \alpha - c + 0.20R(x)$
Portland, OR	$P(x) = \alpha - c + R(x)$
St. Paul, MN	$P(x) = \alpha - c + 0.50x + R(x)$ if $R(x) \leq 50x$
	$P(x) = \alpha - c + 0.50x + 50x + 0.50(R(x)-50x)$ if $R(x)>50x$
San Jose, CA	$P(x) = \alpha - c + R(x) - \Omega$ if $x/M < 0.35$
	$P(x) = \alpha - c + R(x) + \Pi$ if $x/M > 0.40$
	$P(x) = \alpha - c + R(x)$ if $0.35 \leq x/M \leq 0.40$
Seattle, WA	$P(x) = \alpha - c$

Table 5. Estimates of Waste Disposal and Waste Diversion Costs (in $/household/year)

	Waste disposal	*Waste diversion*
Portland	$143	$ 67
Seattle	101	54
San Jose	82	105
San Jose adjusted*	92	96

Source: ILSR 1998. Waste diversion includes yard waste composting and recycling.

*These numbers allocate some of the incentive payment more broadly to collection costs, as described in the text.

Appendix A: Data and Information Sources for Table 3

The starting point for information for all seven communities—in fact, the way that the communities were identified in the first place—was the Institute for Local Self-Reliance's 1999 study for the U.S. Environmental Protection Agency, *Cutting the Waste Stream in Half: Community Record-Setters Show How.* We then searched on the Internet for basic information on each community and the governmental agency responsible for solid waste and recycling. We contacted each community directly and whenever possible obtained a copy of the contract between the local government agency and the private firms responsible for waste collection and recycling. All Web sites referenced below are current as of November 10, 2003.

Ann Arbor, MI

Agreement between Recycle Ann Arbor and City of Ann Arbor for Recycling Collection Services, 1998.

City of Ann Arbor, Recycle Collection Services Renewal Agreement, September 19, 2001; Contract Amendment, September 6, 2001.

City of Ann Arbor Solid Waste Management Plan Update 2001–2006, draft for review, March 2001. Available at http://www.ci.ann-arbor.mi.us/framed/solwste/index.html.

Personal communication with Richard Smoot, Business Manager, Recycle Ann Arbor, July 15, 2002.

Recycle Ann Arbor Web site: http://www.recycleannarbor.org/index.html.

Resource Recycling Systems, Inc. Web site: http://www.recycle.com/rrsi/index.html.

Information on operation of recovery facility and transfer station: http://www.casella.com/fcr.

Bellevue, WA

City of Bellevue, Solid Waste, Recyclables, and Yard Waste Collection Agreement, April 1994. Amendment No. 2 to Agreement.

City of Bellevue Web site on residential garbage rates: http://www.ci.bellevue.wa.us/page.asp?view=9159.

King County, WA, Web site with landfill and transfer station information: http://dnr.metrokc.gov/swd/SWDINFO/CH_landfill.htm.

Personal communication with Tom Spille, Solid Waste Program Administrator, Resource Management and Technology Utilities Department, City of Bellevue, July 2002.

Fitchburg, WI

Fitchburg Public Works, Request for Proposals for Refuse, Recycling, Yard Waste, and Brush Collection Services, July 16, 2002.

Personal communication with Michael Rupiper, Environmental Engineer, City of Fitchburg, July 2002.

Portland, OR

City of Portland, Residential Administrative Rules and Regulations for Residential Franchised Haulers, July 2, 2001.

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