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Working Paper Series

Working Paper # 02-04
August 2002

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Abstract: Strong local opposition to the construction of solid waste landfills has become commonplace and the siting of landfills in the United States is time consuming and expensive. To ease the siting process, host compensation in exchange for permission to construct a landfill has become popular. The value and nature of host compensation varies dramatically across communities, but the reasons for this variation are relatively unexplored. We construct a national data set consisting of host fees paid by the 104 largest privately owned solid waste landfills in 1996, along with the characteristics of the landfills and the host communities. Our findings suggest that he direct participation of citizens in host fee negotiations, the community knowledge stemming from having hosted a prior landfill, and the presence of state mandates for minimum host compensation all lead to much greater amounts of host compensation. We find that the bargaining position of the landfill developer is less important, in terms of the magnitude of the effect. However we do find evidence that firms with deeper pockets are more likely to pay higher host fees. We find limited evidence that a community's race and income level matter after accounting for factors that directly reflect citizen involvement. The analysis also indicates that landfills that accept risky wastes, such as contaminated soil or sludge, and problematic wastes, such as tires pay higher host fees.

Keywords: host compensation, landfills, environmental justice
Subject areas: solid waste, distributional effects

[1] All authors are economists at the National Center for Environmental Economics, United States Environmental Protection Agency (EPA). The authors would like to thank John Hyle and Kelly Miller, who conducted the phone survey while they were students at St. Mary's College of Maryland, and Julie Hewitt, Ron Shadbegian and Ann Wolverton for helpful comments. We express gratitude to Karen Palmer and Margaret Walls for comments and feedback during the early stages of the project; and to Resources for the Future and St. Mary's College of Maryland for financial support also during the early stages of the project. The views in this paper are those of the authors and do not necessarily represent those of the EPA. This paper has not been subjected to EPA's review process and therefore does not represent official policy or views.

1. INTRODUCTION

During the 1980s and 1990s, strong local opposition to the construction of solid waste landfills became commonplace and the siting of landfills in the United States became progressively more time consuming and expensive.[2] By the late 1980s, monetary payments and/or gifts in-kind in exchange for permission to construct and operate a landfill became popular in the negotiations between landfill developers and communities. These offers, known as "host community compensation" or "host fees," consist of cash payments or in-kind gifts that are paid to a community by the developer for the right to site a landfill within the community's jurisdiction.[3] We analyze the wide variation in the host fees paid by the largest U.S. landfills to determine if, and how, the variation is related to issues of efficiency and bargaining power.

The opposition to a particular landfill siting arises from a concentrated population -- the political jurisdiction associated with the potential host community, in particular, the city or county or both where the landfill will potentially be located. The reasons for such opposition stem from the negative externalities imposed by a landfill. Landfills can be noisy, odiferous, and carry a negative stigma for the host community. While some of the negative externalities of a landfill will be imposed on communities outside the political boundary of the host community, a developer is less concerned with opposition from these communities since they have little, if any, legal power to oppose the siting. It is the

[2] According to Repa (1990) siting a municipal solid waste landfill requires an average of five to seven years. Glebs (1988, p. 85) reports that the process of obtaining a permit to open a landfill takes at least two to five years.

[3] Host fees are distinct from tipping fees. Individuals depositing waste pay tipping fees *to* a landfill operator, while host fees are paid *by* a landfill operator to its host community for the right to site and operate a landfill.

host jurisdiction that holds a credible threat of lengthy and expensive legal dispute (Ingberman 1995).

In contrast, the beneficiaries of a landfill are diffuse -- the households in a large multi-county or multi-state region surrounding the landfill. These households are provided with a convenient trash disposal location. This diffusion in benefits has grown over the last several decades as small local landfills have been replaced with regional ones. In 1988, the US Environmental Protection Agency (EPA) promulgated rules governing construction and operation of municipal solid waste landfills (Federal Register, 1991). These regulations have led to substantial economies of scale. For example, EPA requires landfill liners, leachate collection systems, and post-closure monitoring plans all of which impose costs with large fixed components. The fixed costs must be paid regardless of landfill size thus larger landfills became more cost effective. Evidence of the economies of scale is the dramatic decline in the number of landfills operating in the U.S., from almost 8,000 in 1988 to about 2,300 today (USEPA, 2002), while the tonnage disposed of has declined only slightly.[4] Today, the waste from a particular household may cross many political jurisdictions before reaching its final destination, whereas a few years ago each community had its own local landfill.

Complicating the siting process is the difference in relative concentrations of the benefits and costs of the landfill to the local populations. Despite the fact that landfill benefits may outweigh the costs, because the benefits are more diffuse the beneficiaries are less likely to advocate for a landfill than the host community is to oppose it. The proposed site is usually undefended by the large number of benefiting households

because their *per capita* benefits are low, relative to the *per capita* costs imposed on the host jurisdiction (O'Hare, et al., 1983).

Host fees have evolved as an effective means to ease the siting process. However, the fee amounts are far from uniform. For example, in 1996, a city in Virginia received generous donations to various community programs such as the YMCA worth a total of $5000; while a city in California received fees per ton of waste entering their landfill totaling over $20 million. While most states in the U.S. do not mandate host compensation for solid waste landfills, there are at least four, Georgia, Massachusetts, New Jersey, and Pennsylvania, that require private landfills to pay host communities a fee of at least $1.00 per ton of waste received. The variation in host compensation across landfill sites and the factors that influence compensation are relatively unexplored. We are aware of only two studies that empirically examine the determinants of host fee compensation and both focus exclusively on the state of Wisconsin (Himmelberger, et al. 1991, and Nieves, et al. 1992). Related studies have examined the determinants of the decision to site or expand a hazardous waste facility (Hamilton 1993, 1995) but do not analyze host compensation.

For the current study we have constructed a unique national data set consisting of host fee values (both cash payments and monetized gifts) paid by the 104 largest privately owned solid waste landfills in 1996. We combine this data with information on the characteristics of these landfills, such as their size and what types of waste are accepted, as well as characteristics of the host communities including, for example, racial

[4] The amount of waste generated by U.S. households has increased steadily but there has been an offsetting increase in the percentage recycled.

composition and population density. We use this information to examine the determinants of host compensation across communities.

In principle, we would prefer to combine data for communities where landfills have been successfully sited with data for two other types of communities for which, unfortunately we do not have data. Some communities are considered by landfill developers but eventually rejected in favor of an alternative. Other communities would be willing to host a landfill but are not approached by a developer. The lack of representation in our data set of communities facing these two scenarios presents a sample selection problem that should be addressed by future research.

Two issues that often arise in studies that examine siting decisions are the unit of analysis and the timing of the analysis. For the current paper, the unit of analysis is the political jurisdiction; that is, the city and/or county where the landfill is located.[5] Previous research has criticized the analysis of large political jurisdictions such as counties as masking impacts (e.g., Been 1994). However, we are examining the compensation received by the community, not the siting decision. Generally, this compensation, such as free garbage collection and disposal, is for goods or services that benefit the entire political jurisdiction, rather than a particular neighborhood or population.[6] Therefore, the appropriate unit of analysis is the political jurisdiction that negotiates and receives the host fee.

In terms of timing, previous research has also been criticized for failing to distinguish between conditions at the time of siting versus current conditions, the latter of

[5] In some cases both the city and county receive a host fee. We provide more details regarding the data in a later section.

[6] This is generally, but not universally, true. Some payments are for services to residents near the landfill site, such as free deep groundwater wells.

which would be driven by market forces rather than intentional disproportionate siting. Again, the issue for host payments is different. Host payments can potentially be re-negotiated at any time. In practice, even when contracts for host fees are made for multiple years, the threat of a lawsuit, bad publicity or bad community relations, could potentially lead to a re-opening of host fee negotiations. In principle, the present paper would match socio-economic data to the year of the host payment or possibly to the year that the host payment was negotiated. Our data are for host fees paid in 1996, which we match to 1990 socio-economic census data.

The remainder of this paper is organized as follows. Section 2 briefly reviews the related literature. We describe our data in section 3 and explain empirical results in section 4. Finally, we offer concluding comments in section 5.

2. CONCEPTUAL FRAMEWORK

Three possible theories for explaining variations in compensation across communities arise in the literature. Host fees may enhance the efficiency of siting decisions and thus vary according to the value of the negative externalities associated with the landfill (O'Hare 1983). Alternatively, the variation in host fees may be a result of the relative bargaining power between the firm and community. Finally, host fees may simply be lower in certain communities, such as poor and minority areas, because of discrimination.

Compensation has been presented as a practical means for enhancing efficiency – host payments can compensate for negative externalities and lead firms to internalize external costs (e.g., O'Hare 1983). The Coase Theorem predicts that landfills will locate

in areas that will experience the least damage and thus demand the least compensation. In these areas, the magnitude of negative externalities is smaller or the externalities are valued less; that is, willingness-to-accept values are low. To the extent that these are poor or minority communities, efficient siting might occur disproportionately in these neighborhoods. If host compensation is determined largely by efficiency factors, then values might vary positively with the value of negative externalities.

Host compensation has also been discussed as an outcome of relative bargaining power between the siting firm and the host community. For example, Hamilton (1993, 1995) discusses how host payments relate to the extent of collective action in the community (ie, the degree to which residents work together for a common goal, such as demanding compensation for siting rights). The current paper examines the importance to host fee values of the firm's ability to pay as well as direct citizen involvement in host fee negotiations, the community's experience with hosting a landfill and, finally, the community's awareness of the possibility of host payments.

Finally, there is an extensive literature on the siting of "locally unwanted land uses" or LULUs, including landfills, as well as hazardous waste facilities, prisons, and nuclear power plants. These studies examine where facilities are actually located and how these decisions relate to the demographic and socio-economic characteristics of the host community (e.g., GAO 1983, UCC 1987, Been 1994). Typically this research examines whether siting occurs disproportionately in poor and/or minority communities. Along a similar vein, we examine whether host fees vary with the socio-economic characteristics of the host community; specifically, we examine whether racial

composition and income levels remain important even after accounting for factors directly related to community involvement.

These theories are not mutually exclusive. For example, race and income may directly affect compensation, as well as affect the bargaining power of a community. While we do not test these theories directly, we rely on this framework to motivate why we might expect compensation to vary across communities.

2. RELEVANT LITERATURE

While host fees have become a common feature of landfill siting negotiations, there are few quantitative analyses of the determinants of the amount of compensation. We are aware of only two such published studies, both of which limit their analyses to landfills sited in Wisconsin.[7] Himmelberger, et al. (1991) and Nieves, et al. (1992) analyze data on compensation negotiated between 1983 and 1988 for 24 solid waste, sewage sludge and other non-hazardous landfills in Wisconsin. In 1981, Wisconsin passed a unique law providing incentives to communities to negotiate with landfill developers for compensation packages to offset local adverse impacts. An important part of the law is that it removes the host community's right to veto the landfill siting decision (White, et al., 1990). This provides strong incentives to the community to engage in negotiations with the landfill developers.

Himmelberger, et al. (1991) find that compensation per ton of waste increases with the share of the landfill allocated to host community use and in communities with higher poverty levels. The latter finding is explained as an indication that compensation

is a tool for alleviating inequities. The researchers also find that compensation per ton is higher for solid waste facilities (as opposed to sludge waste ones, for example) and public facilities, in both cases because of a greater likelihood for free or reduced fee disposal to be part of the compensation package.

Nieves, et al. (1992) append to the Himmelberger data set new variables representing the landfill developer's assessments of the intensity of host community concerns raised during negotiations. The authors find that the capacity of the facility (in tons) has a significant and positive impact on the net present value of the host compensation package. This result supports the efficiency hypothesis that the compensation somehow "corrects" for negative impacts, which are likely to be greater from larger facilities.

Others highlight potential problems with compensation. For example, Bullard (1992) asserts that compensation only serves to widen inequities between income groups. Poor communities will be forced to accept a compromised environment because of the need for compensation offered by the landfill developer, whereas wealthy communities will reject offers outright. Frey, et al (1996) concludes that compensation does not help to ease siting decisions because it is viewed as either a bribe or because it crowds out public spirit. In the latter case, the authors state that those who are likely to support public projects for siting LULUs because they feel that it is for the overall public good (ie, we all need a place to put our trash) will be less inclined to do so when offered compensation. The compensation deprives these people of their feelings of public spirit.

[7] A third paper (White, et al 1990) compares compensation paid at 26 Wisconsin landfills to that paid at 57 northeastern and Californian resource recovery facilities.

These studies have done little in the way of analyzing actual compensation schemes. Rather, much of the literature related to LULUs examines whether siting occurs in areas that are disproportionately composed of minority populations or disproportionately poor. In a 1983 study, GAO examines the racial characteristics in the communities surrounding 4 hazardous sites in the southeast U.S. They find, using simple means, that the percent of minorities was greater than in the surrounding areas for three of the four sites. Thus, they conclude that minority populations are disproportionately exposed to hazardous pollutants. A UCC report (1987) performed a similar analysis and found that the percent of minorities in zip codes with a hazardous site was greater than in sites without a site. The authors conclude that minority groups have greater exposure to toxics.

Two studies, Hamilton (1993, 1995), examine the determinants of a positive decision to site or expand a hazardous waste facility. Hamilton (1993) hypothesizes that communities facing identical potential losses from a noxious facility may differ in opposition because of differences in rates of political participation. To measure willingness to engage in collective action, Hamilton uses the percent of a county's voting age population that voted in the 1980 presidential election and compares counties with hazardous waste facility expansion plans in 1986 to counties without such plans. He finds that voter turnout is significantly different across the two sets of counties. Hamilton concludes that hazardous waste developers do take into account the potential for areas to engage in collective action.

Hamilton (1995) compares zip code neighborhoods targeted for hazardous waste facility expansion between 1987 and 1992 and those not targeted. He conducts a logit

analysis and finds that voter turnout has a significant negative effect on the probability that an expansion will be planned. This finding is robust whether voter turnout is measured as the actual percent of voters who participated in the 1980 presidential election or as a predicted value for voter turnout modeled as a function of demographic variables which, at an individual level, are thought to influence political participation.

Been (1993) reviews a number of studies, including the GAO and UCC reports and concludes that the analyses are flawed. The unit of analysis was often incorrect and too large to truly capture inequities. In addition, market forces could have driven the results. That is, facilities may have located in particular areas for reasons other than race and income of the nearby residents. Then, the presence of the facility depressed property values, changing the race and income make-up of the area. Been (1994) conducts a new analysis, redoing the GAO analysis by correcting for the issues described above. Interestingly, she finds that at the time of the siting decisions all four sites consisted of populations that contained a majority of African American, indicating that market forces did not necessarily drive the results.

Aurora and Cason (1999) provide additional evidence of disproportionate siting. They find that toxic releases, as measured by the TRI, are greater in minority communities and areas with higher poverty rates, but releases are also higher in areas with greater median income levels.

Others have found no evidence of disproportionate siting. Been and Gupta (1997) address some of the concerns in Been (1994) and conduct a national analysis of communities hosting hazardous waste facilities. Refining the unit of analysis to census tracts, they find little evidence of disproportionate siting with respect to race. Wolverton

(1999) finds that reductions in pollution are greater in minority communities using TRI data in Texas. Baden and Coursey (2002) study census tracts and also find little evidence of disproportionate siting with respect to hazardous waste sites in the city of Chicago. They do find mixed evidence of greater numbers of sites in areas with a high percentage of Hispanic residents.

3. DATA DESCRIPTION

The data for our analysis come from Chartwell Information Publishers, the Bureau of Census, and a telephone survey of solid waste coordinators. Chartwell Information Publishers publishes an annual directory of solid waste facilities in the U.S., including landfills, transfer stations, and incinerators and waste-to-energy facilities (Thompson, 1996). Data in the directory include the name and location of each facility, ownership status (ie, public or private), name and address of owner and operator, and average daily intake and tipping fees. We purchased additional data on revenue and capacity for the 104 largest privately owned landfills in the U.S., where size is determined by the average tons of waste received per day.[8] These 104 landfills form the basis of our analysis.[9] We focus on privately owned landfills given that these are the types of landfills most likely to pay host fees.

Next, we conducted two telephone surveys in order to obtain host fee data for each landfill. First, we administered a brief, simple survey of state solid waste managers

[8] Alternative measures of size include landfill acreage and capacity (total tons of space available). We chose to use the tons of waste received per day because this measure best captures the extent of possible negative externalities, or risk, as well as the level of activity at the landfill (landfills receiving more tons are more "active").

in each state where the 104 landfills are located (over 30 states).[10] The primary purpose of this survey was to gather information regarding the appropriate local contact for each of our landfills. Because municipal solid waste landfills are regulated at the local level and each state and community differs in terms of the title and department where its solid waste officials reside, the survey of state officials was our best source of this information. The state contacts also provided us with information regarding state mandates or other laws regarding host fees and community rights to reject a landfill.

Following this simple survey, we developed a more extensive survey to administer via telephone to the local contacts associated with each of the 104 landfills.[11] The purpose of this survey was to obtain detailed information regarding the host fees, if any, the community receives and the nature of the siting negotiations with the landfill developer.[12] Over the course of 1997 we attempted telephone contact with public officials in the city or county where each of the 104 landfills is located. We succeeded in reaching a knowledgeable official for 90 landfills, representing an 87% response rate. We queried these officials about features of the landfill facility such as its age and acreage, characteristics of the host fee negotiation process, such as whether citizens were directly involved, and the value and nature of the host fee itself.

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[9] The landfills ranked 100 through 104 were indistinguishable in terms of size. Therefore, our dataset consists of the 104 largest landfills in the U.S. While we would have liked to study the landfill population, time and budget constraints forced us to limit our analysis.

[10] In 1996 the Maryland Department of Environment completed a national solid waste survey of state governments, identifying a state level official knowledgeable about solid waste management in the state. We relied on these results for our state contacts.

[11] An appendix with a copy of the survey instrument is available upon request.

[12] We briefly contemplated calling the landfill directly (since this information is available in the Chartwell Directory) and requesting this information. However, because the landfills in our sample are privately owned, extracting this information would have been impossible. Indeed, early in the project we requested and were denied information regarding host compensation from one of the largest landfill owners in our dataset.

Prior evidence suggested that the value and nature of host compensation is quite diverse. In order to ensure consistent reporting of the different potential categories of host compensation, we prompted officials with a series of questions regarding the nature of the host fee. Specifically, we identified five types of host fees and queried officials regarding their receipt of each type, the value of each type of fee in 1996, and any other clarifying information regarding the type of fee. The five types of fees are: per ton of waste received; percent of revenue received by the landfill; in-kind gifts; free collection, disposal, or recycling services; and property protection, hiring preferences, or reimbursement for negotiation expenses. Each type is fairly self-explanatory, but briefly, per-ton of waste and percent of revenue are values attached to the associated quantity of waste or dollars. For example, the community may receive $1/ton or 1% or the landfill revenue in the form of a host fee. Alternatively, the community may receive in-kind gifts, such as free deep wells for nearby residents or the use of a park built by the landfill. Some communities also receive free (or reduced) collection, disposal, and/or recycling services. And finally, some landfills gave their host community preferential hiring or reimbursement for negotiation expenses. In general, among communities that do receive host compensation, multiple types are received.

Table 1 provides a summary of the types of compensation received by the landfills in our dataset. The most prevalent form of compensation is payment per-ton of waste received by the landfill. This form of compensation is most directly related to the volume of activity (or waste) at the landfill and therefore it is not surprising that it is the most popular compensation mechanism. The next most prevalent compensation is in the form of in-kind gifts. As mentioned above, these gifts vary tremendously in their form

and value. Typically, gifts are given in addition to some other form of compensation. Indeed, 85 percent of communities that received gifts received some other compensation in addition to the gifts.

For each case where the respondent identified a type of host fee received by their community, we asked for the estimated dollar value of the host fee. For example, if the host fee was paid per ton, we asked for an estimate of the total value of per-ton compensation in 1996. In some cases the respondent was unable to provide a dollar value associated with a type of compensation. For example, the respondent may have known that the community received $1.00 per ton, but did not know the total value in 1996 or the respondent knew the community received a free collection truck, but did not know the value of the truck. Because we are ultimately interested in the value of the host fee, it was necessary to monetize the qualitative responses.

The most challenging aspect of assigning values for host fees was monetizing the in-kind gifts received. The types of gifts communities received varied tremendously, as mentioned earlier. In order to monetize these gifts, we first sorted them according to whether they were one-time gifts or gifts received repeatedly (e.g., annual or biannual gifts). Because our analysis is a snap shot view of the determinants of host compensation in one year, 1996, we needed to convert all gifts into a one-year value. This required depreciating one-time gifts and annualizing repeated gifts. We took each non-monetized gift on a case-by-case basis, using on-line information and average values from other observations in the sample to determine each gift's value. For example, one city received a new collection truck in 1990. To estimate its value in 1996, we calculated the average

value in 2001 (the most recent data available) of a 6-year-old collection truck (ie, used) according to an on-line garbage truck dealership (www.rdk.com), or $54,000 ($1996).

As another example, one landfill offered to buy all homes within 800 feet of the landfill. Based on Bureau of Census data, we estimated that there were approximately 352 homes per square mile in this city, or 53 homes in 800 feet (800 feet is 0.15 of a mile). We then multiplied this figure by the median home value in the community to obtain the total value of this gift, or $3.7 million ($1996). Once we had estimated values for each of the one-time gifts we annualized them according to the following equation:

$$AC = PVC\left[\frac{r(1+r)^{n}}{(1+r)^{(n+1)} - 1}\right]$$

where AC is the annual cost or value of the gift, PVC is the present value of the gift, r is the interest rate, and n is the time horizon. We assumed various time horizons according to the type of one-time gift; in cases where the gift did not expire naturally (e.g., a park), we assumed the time horizon expired when the landfill was estimated to close (information available in Chartwell). We also assumed a 3% interest rate. Once we monetized each component of the host fee we summed the values to estimate total 1996 host compensation for each community.

The final step in creating our data set was to merge socioeconomic data for each city and county with the host fee and landfill data. We used the Bureau of Census data, based on the 1990 Census, the most recently available data and most appropriate for a 1996 analysis. The county data are relatively straightforward; each landfill is located in a

particular county and Census publishes data for every county in the U.S. The city data, however, were more disagreeable because Census does not recognize all cities, particularly small villages or suburbs. In these cases we located the next closest city, which was most often the city within which the suburb or village was located.[13] For example, American Landfill is located in Apex, Nevada, which is an industrial park. The nearest city is North Las Vegas, Nevada and therefore we used the characteristics associated with this community in our analysis. Once we identified a city for each landfill we included the relevant variables, as listed in table 2, with the exception of the VOTE variable, in which we used the county data for lack of an alternative source.

A single landfill might pay its host county one compensation package and its host city a different package. To reflect both compensation payments, our data set includes two observations per landfill, one for the city and one for the county. After deleting some observations due to missing information, our final data set consists of 142 observations.[14]

Table 3 shows the descriptive statistics for the variables in our analysis. Host fee values range from $0 to over $20 million, with a mean host fee of $750,000. Approximately 52% of the observations represent locales that receive no host fee. Table 3 separates the independent variables into four categories: variables that measure risk or quality-of-life effects of the landfill, firm power variables, community power variables,

[13] This type of aggregation at the city level could compromise the impact of our variables on host fees. However, the political jurisdiction negotiating the siting and host compensation with the landfill is likely to be the city identified by Census, the larger city within which the landfill is located. The characteristics of the political jurisdiction are relevant for determining the amount of host compensation.

[14] Several landfills paid separate host compensation packages to their host counties and to two host cities thus there are three observations associated with them. For other landfills, we have a missing county observation but a non-missing city observation, or vice versa. This explains why the number of observations in the final data set is not twice the number of landfills represented.

and socio-economic characteristics of the community. If host fee negotiations are dominated by efficiency considerations, and host fee values are determined primarily by the value of negative externalities, then the risk and quality of life variables should prove important. Alternatively, if host fee values are determined primarily by relative bargaining power or even pure discrimination, then the firm and community power as well as the socio-economic characteristics should be important in determining host fees.

There are eight risk and quality-of-life variables. The proximity of the landfill to the nearest subdivision is an indicator of the extent to which the community could potentially be affected by contaminants from the landfill. Subdivisions typically consist of a grouping of homes situated near one another. The closer to a subdivision the landfill is located, the greater the potential health risks posed by the landfill and the greater the quality-of-life effects such as odors and stigma. On average, the closest subdivision in our sample is a half mile from the landfill, however, the nearest is adjacent to the landfill (proximity is zero), and the furthest is 5.5 miles. An indicator variable for whether homes near the landfill rely on well water is also included. Contaminants that leach from the landfill into the groundwater can affect drinking water wells; the closer the landfill is to a well the greater the potential for contamination. Approximately half of our observations represent communities with homes nearby the landfill that rely on well water.

Additional risk and quality of life variables include the population of the host community. The larger the population, the greater the number of people affected by the landfill. The range of population for our sample is large – from about 200 to over 9 million. Approximately 76 percent of the observations represent landfills that accept waste generated by households residing outside the host state. These host communities

may perceive a higher level of risk than hosts to landfills receiving only in-state waste. Most of the landfills in our sample accept what we consider to be "high-risk" wastes; 59% and 88% accept asbestos and contaminated soil, respectively. Fewer landfills accept the mid-risk wastes, sludge and tires. As the level of risk increases or quality of life decreases we hypothesize that the host fee will be higher.[15]

To measure a firm's bargaining power, we include four variables. We include an indicator variable for when Browning Ferris, Laidlaw Waste Systems, or Waste Management, Inc own the landfill. These are by far the three largest landfill operators in the US, representing 63% of the observations in our dataset. We expect these firms to be most familiar with landfill siting issues and therefore able to exert extensive power in negotiating a favorable (to the firm) siting agreement. The firm's tipping fee and capacity also measures firm power. Higher tipping fees provide the landfill with greater revenue, while larger landfills are also likely to generate more revenue. In addition, we include an indicator variable for whether the landfill developer is located in a different city than the host community. Firms located in the same city as the landfill should be more familiar with local issues and thus able to use this information to their advantage in the siting negotiations. Over 75 percent of our observations represent landfill developers located in different cities from the landfill site.

The bargaining power of communities is indicated via five variables. One is an indicator variable for direct citizen involvement in the host fee negotiations -- almost 20 percent of our observations represent such negotiations. Communities may engage in a

[15] Better measures of risk than what we have included would reflect information about the soil and topography at the landfill site, the number of residents within a certain distance of the landfill, and the age of the landfill. This information was unavailable.

lawsuit with a landfill if the parties are unable to reach a compromise regarding the proposed siting. Sixteen percent of our observations represent negotiations in which an actual lawsuit was filed over the siting issue. Along the same vein as Hamilton (1993, 1995), we measure the community's inclination towards collective action as the proportion of the adult population who voted in the 1994 presidential election. On average, the percent voting in the communities represented by our data set is 57 percent. The range of values for this variable is quite large, from 41 to 71 percent. Almost 20 percent of our observations represent landfills that have replaced existing landfills. Communities negotiating over a replacement landfill are likely to be well aware of the negative externalities liable to accompany a new landfill and thus should enter the negotiation process with a rich information set. Finally, 6 percent of our observations represent negotiations occurring in states that have mandated a host community payment. Mandated host fees might serve as an important signal to communities that host payments above the minimum required are a viable possibility.

Three socioeconomic characteristics are included in the data set. On average the percent of the population that is non-white is 19 percent for our sample. The range of values for this variable is remarkable -- .1 percent to 72 percent. The average income in the host communities is approximately $34,000. Finally, the average percentage of the population living below the poverty line is 9 percent for the host communities. As compared to national averages, 19.71% of the U.S. population is non-white, median household income in the U.S. was $30,056 ($1990) and 9.97% of the population was living below the poverty line. Hence, our data are fairly representative of the U.S. in

1990.[16] To the extent that there are inequities, in general, associated with the siting of landfills, our data are not reflective of these patterns. Rather, our data are reflective of the national averages for these socio-economic characteristics.

The data set also includes a series of indicator variables when the observation represents a county as opposed to a city (50 percent do) and when the observation represents one of four regions in the U.S. (the midwest is most represented).

4. Results

The amount of host fee compensation is modeled as a function of the risk variables, firm and community power variables and socio-economic variables that are described in Section 3. To accommodate the truncation at zero of the dependent variable -- the amount of host fee compensation -- we estimate a Tobit model. The results of the econometric estimation of the Tobit regression are presented in Table 4. These results indicate the significance and direction of each variable's effect on the amount of host compensation. Because of the non-linear estimation procedure employed, the regression results in Table 4 do not provide a good indicator of the magnitude of the effect. To determine magnitudes, we use the estimated Tobit model coefficients to calculate the marginal effects of different independent variables on the amount of host compensation. For the significant variables, these marginal effects are reported in Table 5.

To address a concern that the error terms for the city and county observations associated with a single landfill might be correlated, we estimated a seemingly unrelated

[16] American Factfinder, 1990 data.

regression model. Our results suggested that there was no significant correlation.[17] The results for the models estimated separately for the city and county are presented in Table 6.

The diverse nature of the communities in our data set led us to question the appropriateness of the standard assumption that all of the disturbance terms in the underlying model have a common variance. In particular, we suspected that the variance of the disturbance terms surrounding the amount of host fee compensation could be a function of the income level of the community. We hypothesize that the variance of the regression disturbance terms are likely to be different for communities with high average income levels than for communities with lower average income levels. Those with high incomes are likely to have less variation in errors. These communities are likely to be fairly consistent in exerting effort to gather information about an incoming landfill and negotiate effectively for compensation. Lower income communities seem more likely to exhibit inconsistency across communities in the amount of effort targeted at negotiating for compensation. Using income as the determinant in a multiplicative model of heteroskedasticity, we corrected the Tobit model for the presence of heteroskedasticity.[18]

Finally, we were particularly concerned about feedback between the dependent variable and the variable that measures the proximity of the landfill to the nearest subdivision. We wished to test for the possibility that a community simultaneously determines the proximity to the nearest subdivision and the amount of host fee compensation during the siting process. Using the instrumental variable technique, we modeled the proximity of the landfill to the nearest subdivision as a function of the same

[17] The correlation coefficient was 0.1660.

right hand variables explained in Section 3 plus several additional variables. We added a variable measuring the density of the population living in the community hypothesizing that the more unpopulated space available, the easier a landfill developer would be able to add distance between the landfill site and neighborhoods.[19] The decision about proximity must be made when the landfill is sited whereas the amount of host fee compensation can be revised over time. Thus we hypothesized that any variable related to the siting decision might affect the proximity to the nearest subdivision. We include an indicator variable for whether there were lawsuits over the siting of the landfill. This occurred in sixteen percent of the communities. We also include a series of indicator variables indicating which unit of government negotiated with the landfill developer over the landfill site.[20] Our results indicate that the amount of the host fee compensation is independently determined relative to the proximity of the site to the nearest subdivision. We attribute this finding to the possibility that the host fee amount can be re-negotiated over time whereas the landfill site is a more permanent decision.

4.1 The Risk Associated with the Landfill

Two of the variables that measure the population's exposure to risk from the landfill and the quality-of-life effects of the landfill are significant. We find that the greater the distance between the landfill and the nearest subdivision, the higher the value of the host compensation package. Communities who are savvy enough to negotiate for a

[18] We applied Huber-White's heteroskedasticity correction.
[19] The density variable is measured as the number of residents (in 000s) per square mile. Its mean value is 1.45 with a standard deviation of 1.45. Its values ranged from 0.01 to 8.06.
[20] Specifically, we added four indicator variables characterizing the government unit that negotiated for the host fee. There were five possibilities: a local government unit such as a city, town or municipality; a

high host fee also demand distance between the landfill and housing developments. The marginal effect is large. An additional mile of distance is associated with approximately $230,000 more in host compensation. This suggests an inverse relationship between negative externalities and host compensation.

A second significant risk factor is whether or not a landfill accepts tires. We find that landfills that accept tires pay substantially higher host fees. The marginal effect is approximately $475,000. Tires, while not the most dangerous of wastes, are problematic in a landfill because they are voluminous and can float to the surface. This can de-stabilize a closed landfill. Once at the surface, tires are flammable and attract mosquitoes. The indicator variables for the two riskier waste categories – asbestos and contaminated soil – are not significant in the pooled model. However, the results for the separate Tobit estimation of the county observations indicate that landfills accepting contaminated soil and sludge pay higher host fees as well as those accepting tires. For the city model we find that only sludge results in greater payment. Consistent across all three models is that the type of waste is an important determinant of compensation.

Overall, we find conflicting evidence that host fees are used to compensate communities for the negative externalities imposed by a local landfill. The fact that host fees increase as the distance between the landfill and the nearest subdivision increases, suggests that host fees do not offset negative externalities but that communities are successful in negotiating both a high host fee and low negative externalities. However, with the exception of asbestos, host fees tend to increase when riskier or more

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county; a state; both the local unit and the county; or the local unit, the county and the state operating together.

troublesome categories of waste are accepted at a landfill. Thus, host fees may serve to compensate for risk introduced via categories of waste accepted.

4.2 *The Firm's Bargaining Position*

Our findings regarding the variables measuring the firm's bargaining position are the least consistent across the pooled, city and county models. For the pooled model, only the indicator variable for landfill ownership by one of the "big three" landfill developers is significant. These developers pay $234,000 more in compensation, on average. It could be the case that these firms are more aware of the compensation needed to site a landfill and offer an appropriate amount rather than spend time negotiating for something less. For the model of host payments to counties, this indicator variable is significant as well as the amount of tonnage accepted (CAPACITY) and whether the developer is located in the same city as the landfill site (CITY). The more tonnage accepted, the higher the revenues received by the landfill company thus the positive association between tonnage and host compensation for the county model is not surprising.[21] The same logic might explain the positive association between the tipping fee value and host compensation in the city model. For the county model, a landfill developer located in a different city from the host community pays less compensation than one located in the same city. Perhaps negotiators representing such developers are savvier than home-based ones.

Overall, the variables associated with a strong resource base for the firm are positively correlated with greater host compensation. We find more limited evidence that landfill developers located out of town are likely to pay less host compensation.

4.3 The Host Community's Bargaining Position

The results for the variables that reflect a host community bargaining position are highly consistent across the three models. For all, the indicator variable for whether citizens were involved in the negotiations for the host fee (NEGOTIATE) is positive and significant. The marginal effect of citizen involvement is large -- $440,000. We consistently find that landfills that are replacements for existing landfills already located in the community pay significantly higher host fees. Communities negotiating about a replacement landfill are likely to be better informed about the actual risks and quality-of-life changes introduced by a landfill. They should be in a better position to present a cogent argument for why compensation is necessary.[22] Landfills that are replacements for older landfills pay substantially more -- approximately $1,250,000 -- in host compensation. Finally, the indicator variable for communities located in states that mandate a host payment is significant across all three models. In our sample, there are three states that mandate a minimum host fee of $1.00 per ton – Georgia, Massachusetts and Pennsylvania. These mandates ensure that a minimum host payment is received. In addition, a mandated fee might serve as an important signal to host cities and counties that host compensation is justified and that compensation above the minimum should be requested. The marginal effect of a state mandate for host fees is large -- $1,771,000.

Unlike the findings in Hamilton (1993, 1995) we find that the percent of the host population that voted in the previous presidential election is not significant to the host fee value. This is the only variable Hamilton includes to represent the community's

[21] This positive association might also reflect compensation for the greater negative externalities that are associated with greater intake of garbage quantities.

inclination toward collection action. Perhaps the importance of the population who votes is diminished in our study by the inclusion of additional variables to represent community bargaining power. Gray and Shadbegian (2002) obtain a result similar to ours and find that the percentage of the population that voted is insignificant.

In sum, the bargaining position and perspective of the host community is quite important to the amount of compensation. Direct citizen involvement in the negotiations, familiarity with an existing landfill and a state law requiring a host payment all lead to significantly greater amounts of host compensation.

4.4 Socio-Economic Variables

The results for the socio-economic variables are somewhat inconsistent across models. For the pooled model, the indicator variable for whether the unit of government receiving the host fee is a county, and not a city, is significant and negative. This suggests that we examine the Tobit model separately for city and county as in Table 6, and that counties receive less compensation than cities. The latter result might be due to less cohesion among county populations than among city populations. For the pooled model we also find that landfills located in the South or Northeast pay significantly smaller host payments than landfills located in the Midwest. One might have expected the South to receive lower payments. However, our expectations were that landfills located in the Northeast would receive higher payments. The Northeast region is not well represented by our sample, only 14 percent of our observations are located there (see Table 2).

[22] A different possibility is that communities hosting a replacement landfill will be more accepting of a new landfill since they have grown accustomed to the social costs associated with landfill hosting. Our findings do not support this.

As for the pooled model, for the county model we find that the Northeast and South receive significantly smaller host payments. In addition, the three socio-economic variables related to equity issues are significant, two in the expected directions, one in an unexpected direction. For the county model, the percent of the population that is other than white is negatively correlated with the amount of host compensation. The median household income is positively correlated with compensation. Unexpectedly, the percent of the population living below the poverty line is positively correlated with compensation.[23] None of the three "equity" variables are significant for the pooled or the city models.

Hamilton (1993, 1995) concludes that the degree of political activism in a community can account for the disparities in hazardous waste expansion plans between communities with low and high minority populations. The results for the county model run counter to this assertion. Despite that we have included, and find significant, variables to represent directly the involvement of citizens in host fee negotiations, the familiarity of residents with landfills, and the presence or absence of state mandates for host compensation, the coefficients for race, income and poverty are still significant. Thus the results for the county model might be indicative of discriminatory attitudes. However, the results for the pooled and city models are not.

5. CONCLUSION

This paper examines the determinants of host compensation. While there are numerous studies that describe the location decisions surrounding locally unwanted land

[23] This reproduces the finding for Wisconsin host compensation by Himmelberger, et al. (1991).

uses, there are few that explore the determinants of the location decisions and fewer still that examine the determinants of host compensation, a mechanism often used in the siting process for solid waste landfills. We propose two sets of issues that might dominate in the negotiations for host community compensation. Host communities might be bargaining for compensation to offset the effect of negative externalities generated by the landfill. In this case the host payment is efficient in the sense that the landfill developer must internalize external costs. Alternatively, equity issues including bargaining power and pure discrimination issues might dominate the negotiations for host compensation. In this case, the host fee is not necessarily reflective of social costs.

Our findings suggest that the bargaining position of the community is critical to the amount of host compensation received. The direct participation of citizens in host fee negotiations, the community knowledge stemming from having hosted a prior landfill, and the presence of state mandates for minimum host compensation all lead to much greater amounts of host compensation. We find that the bargaining position of the landfill developer is less important, in terms of the magnitude of the effect. However we do find evidence that firms with deeper pockets are more likely to pay higher host fees. We find limited evidence that a community's race and income level still matter after accounting for factors that directly reflect citizen involvement. These variables remain important for the separate model of county host payments.

The analysis indicates that efficiency factors also affect the amount of host compensation. Landfills that accept risky wastes, such as contaminated soil or sludge, and problematic wastes, such as tires pay higher host fees. Contradicting the efficiency hypothesis, however, is our finding that the proximity of the nearest subdivision to a

landfill varies directly with host compensation. This suggests that communities who are savvy host fee negotiators might also successfully negotiate for low negative externalities.

The analysis is limited to host compensation at the largest municipal solid waste landfills. Factors influencing the community bargaining position might be especially important for negotiations with landfill developers who are generally large and wealthy. Future research should examine compensation at small as well as large landfills.

The findings suggest that community's fare better when they are more involved in host fee negotiations and when they are more knowledgeable about the issues surrounding hosting a landfill as well as about the existence of host compensation. To increase the amount of compensation as well as to improve the odds that a community will receive any compensation, policy makers should target their efforts at improving citizen education and involvement.

Table 1: Type of Compensation	
Type	**Percent**
Zero	52%
Per-ton of Waste	31%
Percent of Revenue	4%
In-kind Gifts	16%
Free Collection, Disposal, Recycling	11%
Preferential Hiring, Reimbursement	3%

Table 2: Variable Description	
Variable	**Description**
RISK VARIABLES	
SUBDIV	= proximity of landfill to nearest subdivision, in miles
WELL	= 1 if nearby homes use well water, = 0 otherwise
POPN	= population of community, in thousands
OUTSTATE	= 1 if landfill accepts waste from outside the state, = 0 otherwise
ASBESTOS	= 1 if landfill accepts asbestos waste, = 0 otherwise
SOIL	= 1 if landfill accepts contaminated soil waste, = 0 otherwise
SLUDGE	= 1 if landfill accepts sludge waste, = 0 otherwise
TIRE	= 1 if landfill accepts scrap tire waste, = 0 otherwise
FIRM BARGAINING VARIABLES	
MARKET	= 1 if landfill is owned by Browning Ferris, Laidlaw Waste System, or Waste Management, = 0 otherwise
TIPPING FEE	= Fee charged per ton of waste accepted at the landfill
CAPACITY	= Total tonnage accepted during 1996
CITY	= 1 if owner and landfill site are located in different cities, = 0 if owner and landfill site are located in the same city
COMMUNITY BARGAINING VARIABLES	
NEGOTIATE	= 1 if there was citizen involvement during negotiations with the landfill developer, = 0 otherwise
VOTE	= percent of population who voted in the 1994 presidential election
REPLACE	= 1 if landfill replaces an old landfill in the community, = 0 otherwise
MANDATE	=1 if a state law mandates that the landfill pay a host fee
SOCIO-ECONOMIC VARIABLES	
RACE	= percent of population that is non-white
INCOME	= median household income in community
POVERTY	= percent of population living below the poverty line
LOCATION	= 1 if host fee is paid to a county, = 0 if host fee is paid to a city
MIDWEST	= 1 if landfill is located in the Midwest, = 0 otherwise
NORTHEAST	= 1 if landfill is located in the northeast, = 0 otherwise
SOUTH	= 1 if landfill is located in the south, = 0 otherwise
WEST	= 1 if landfill is located in the west, = 0 otherwise

Table 3: Descriptive Statistics			
Variable	**Mean (std. dev.)**	**Minimum**	**Maximum**
HOST FEE (000s)	750.83 (2373.13)	0	20119.93
RISK VARIABLES			
SUBDIV	0.60 (0.84)	0	5.5
WELL	0.48 (0.50)		
POPN (000s)	506.99 (1252.21)	0.19	9053.65
OUTSTATE	0.76 (0.43)		
ASBESTOS	0.59 (0.49)		
SOIL	0.88 (0.33)		
SLUDGE	0.24 (0.43)		
TIRE	0.27 (0.45)		
FIRM BARGAINING VARIABLES			
MARKET	0.63 (0.49)		
TIPPING FEE ($/ton)	32.99 (13.09)	12.00	80.00
CAPACITY (tons/day)	2214 (1071)	1200	6000
CITY	0.78 (0.41)		
COMMUNITY BARGAINING VARIABLES			
NEGOTIATE	0.19 (0.39)		
LAW	0.16 (0.37)		
VOTE	0.57 (0.06)	0.41	0.71
REPLACE	0.19 (0.39)		
MANDATE	0.06 (0.25)		
SOCIO-ECONOMIC VARIABLES			
RACE	0.19 (0.17)	0.001	0.72
INCOME (000s)	33.90 (7.96)	17.91	61.32
POVERTY	0.09 (0.05)	0.01	0.32
LOCATION	0.50 (0.50)		
MIDWEST	0.42		
NORTHEAST	0.14		
SOUTH	0.29		
WEST	0.15		

Table 4: Pooled Model Tobit Results		
Variable	**Coefficient**	**Robust Standard Error**
RISK VARIABLES		
SUBDIV	799.87*	494.57
WELL	152.66	642.83
POPN	-0.27	0.25
OUTSTATE	-251.94	743.99
ASBESTOS	-865.79	757.10
SOIL	579.07	794.23
SLUDGE	1123.49	776.12
TIRE	1504.98***	566.56
FIRM BARGAINING VARIABLES		
MARKET	833.75*	474.01
TIPPING FEE	44.91	36.35
CAPACITY	0.0014	0.0009
CITY	918.31	782.51
COMMUNITY BARGAINING VARIABLES		
NEGOTIATE	1361.97*	736.22
VOTE	-808.41	5368.51
REPLACE	3274.20***	923.70
MANDATE	3909.80***	965.43
SOCIO-ECONOMIC VARIABLES		
RACE	-5242.99	3461.17
INCOME	93.88	76.63
POVERTY	10437.31	11244.08
LOCATION	-1748.93***	665.48
NORTHEAST	-3550.67***	1250.55
SOUTH	-1688.28**	772.08
WEST	163.67	903.68
Constant	-7411.45	4991.76
Observations	142	
Log-Likelihood	-663.44	

*significant at 90% level of confidence
** significant at 95% level of confidence
*** significant at 99% level of confidence

Table 5: Marginal Effects of Significant Variables	
Variable	**Marginal Effect**
SUBDIV	230.75
TIRE	477.31
MARKET	234.25
NEGOTIATE	440.53
REPLACE	1256.46
MANDATE	1771.12
LOCATION	-508.74
NORTHEAST	-770.30
SOUTH	-449.80

Table 6: Results of Separate Tobit Estimations for City and County		
Variable	**City**	**County**
RISK VARIABLES		
SUBDIV	906.82*	384.06**
WELL	-294.52	-7.71
POPN	-0.56	-0.05
OUTSTATE	-1550.88	-197.07
ASBESTOS	-470.83	-953.84
SOIL	-659.32	991.27*
SLUDGE	1824.33*	911.68**
TIRE	1445.22	1198.47***
FIRM BARGAINING VARIABLES		
MARKET	1131.55	863.71***
TIPPING FEE	91.79**	-10.40
CAPACITY	1.09	1.39***
CITY	1337	-3365.3**
COMMUNITY BARGAINING VARIABLES		
NEGOTIATE	2646.36***	834.03**
VOTE	3053.83	-4216.19
REPLACE	4271.95***	741.83*
MANDATE	3586.04*	2694.72***
SOCIO-ECONOMIC VARIABLES		
RACE	-1351.14	-7020.44***
INCOME	36.89	104.2**
POVERTY	-1736	22626***
NORTHEAST	-2585.07	-7208.8???
SOUTH	-1426.24	-1748.23***
WEST	-252.73	-535.96
Constant	-7981.79	-603.31
Observations	71	71
Log-Likelihood	-409.41	-219.06

Note: These Tobit models are not corrected for heteroskedasticity. To improve comparability with the pooled model, later versions of this paper will include this correction.

*significant at 90% level of confidence

** significant at 95% level of confidence

*** significant at 99% level of confidence

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