Market vs. Government: The Political Economy of NIMBY

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Abstract: Many important social choice problems involve selecting a single community (the "host") to bear the cost of a project which yields positive net benefit for society as a whole (referred to as NIMBYs, for "Not In My Back Yard"). For example, society needs to dispose of its waste, but no one wants a waste facility in their backyard. This paper asks: Should NIMBYs be sited by market or government? To this end, we compare market allocations with allocations derived from governments (i.e., legislative choice with and without voluntary agreements). With either market or government allocation, a key factor in assessing outcome efficiency is whether or not potential hosts possess the ability to make "final" offers. If the allocating institution (rather than potential hosts) has this ability, then inefficient outcomes are likely. We consider the constitutional problem of choosing among these three NIMBY-allocators under a "veil of ignorance", and show that the allocation institution selected need not lead to efficient outcomes, although the institution selected will involve voluntary agreement.

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1. Introduction

One of the most vexing of practical social choice problems occurs when a project that benefits society as a whole imposes substantial costs on a single group. For example, we all agree that having our trash collected from homes and factories and disposed of centrally (in a landfill or trash incinerator) is a good idea; the hard part is deciding who will live next door to this potentially noxious facility. Other examples include nuclear waste repositories and halfway houses for recovering drug addicts.

Such a problem is often called a NIMBY: "Yes, this project is a good idea, but Not In My Back Yard". Indeed, modern developed economies appear to proliferate NIMBY problems: technological and economic processes which create choice and value also may create (directly or indirectly) negative externalities, and there is little open space remaining in which to dispose of these bad side effects. Further, technology has in some cases vastly increased the scope of these externalities, as in the case of high level nuclear waste, the effects of which may last as long as man himself has existed.

A goal of this paper is to compare the outcomes of siting decisions by markets and governments. The instititutional details of any application of markets or governments will matter; in this paper, however, we abstract from much detail to focus on three generic allocation institutions:

1. *Market* A firm (or firms) negotiates with potential hosts to provide compensation in return for siting a noxious facility. An example of this approach is the siting of solid waste landfills by private firms[1].

2. *Government* A legislative body in which all beneficiaries (and other potential hosts) are represented, chooses a site. In particular, we consider

   Decide and Announce[2] A governmental body chooses the host and announces their decision. This body could be a regulatory agency or a legislature (in which the named host is represented). An example of a NIMBY for which this approach is used is in the siting of the low-level nuclear repository in Pennsylvania.

   Legislative Siting with Host Veto The legislature offers a potential host a compensation package (in dollars or political favors) in order to induce the host to accept the NIMBY. The host is not obligated to take the NIMBY, and will only do so if the compensation offered provides sufficient incentive[3]. An example of this approach may be recent legislation regarding high-level nuclear waste repositories[4].

Siting by legislatures under host veto shares an important feature of market siting: voluntary agreement by the host community. Voluntary agreement implies that a key determinant of outcomes is which agent has *bargaining power.* It is no surprise that the distribution of benefits depends upon whether the host or the legislature/firm has bargaining power; it is a surprise that the size of the net social benefits, i.e., efficiency, also depends upon who has the

bargaining power, even when the alternatives are endogenously determined. Further, because different allocation institutions can lead to different outcomes, both in allocative efficiency and the distribution of costs and benefits, the central question addressed by this paper is: If society, through its legislature, is choosing among these three institutions that it can commit to using for all future NIMBYs, which allocation institution will be chosen?

This is the constitutional, or metagame, problem. Clearly, if all benefits and costs of all future NIMBYs is known at the time of the metagame, then legislators -- as community representatives -- will favor the allocation institution that yields their community the highest net present value. We believe it more likely that the constitutional stage occurs under a "veil of ignorance," in which community representatives know the likely distribution of benefits and costs, but do not know their particular outcomes for all future NIMBYs. Therefore, risk aversion becomes a key factor at the constitutional stage.

The principal results of the paper are: (i) The critical factor in determining the efficiency of the outcome is which agent possesses bargaining power. Whether the site is allocated by a government process or a market process is immaterial to the efficiency of the outcome. (ii) The outcome of the metagame (i.e., the allocation institution chosen) depends upon the likely distribution of benefits and costs, with low-variance allocation institutions being preferred ceteris paribus to high-variance ones. This can lead to a allocation institution choice that results in inefficient outcomes.

In Section 2, the model is developed. The major results for the different allocation institutions are derived in Sections 3-4. In Section 5, the metagame is developed and the principal result derived. Section 6 summarizes and concludes the paper, and briefly discusses several extensions.

2. The Model

The economy consists of n communities indexed by $i=1,...,n$; each community[5] behaves as a unitary actor. A NIMBY project is proposed; for concreteness, assume that the project is the collection of the trash of all communities and its disposal at a central landfill. This landfill must be located within one of the communities; whichever community is selected as the landfill site experiences a significant cost in the form of disamenities. After the site has been selected, the government or firm provides the beneficial service (say, trash collection) and uses the noxious facility (say, a landfill) in the host community.

Let z_i = gross benefits from the project by community i, and y_i = cost to community i of being the host, $i = 1,...,n$. This cost y_i includes not only the cost of building, maintaining, and operating the facility, but all disamenities associated with this facility as well[6]. If the project is not implemented, then the *reversion* project is implemented, in

which each community receives net benefits of r_i. The cost y_i of the landfill falls entirely on the host; no other communities are affected by it[7], and that communities are indexed so that $y_1 > y_2 > .... > y_n$.

If the project is not implemented, then each community has the option of implementing the project unilaterally; the costs y_i are sufficiently high that every community prefers the reversion to undertaking the project unilaterally: $z_i - y_i < r_i$. The system is closed in the sense that all costs, including those of host compensation, are borne by the beneficiary communities according to a tax or fee arrangement; no outside subsidies are available. If a project is implemented and compensation C_k to the host k is required, then each community i pays a tax (or fee) of $\tau_i C_k$, if community k is the host, where τ_i is the *tax share* of community i. This tax share is independent of the host[8] and the compensation paid, and $\sum_{i=1}^{n} \tau_i = 1$. Tax shares are exogenous[9] and based upon contractible information, such as tons of trash removed, community income, or assessed value of community property. It is sometimes useful to think of the tax share in terms of a "tipping" fee paid for the landfill use. For example, suppose each community i generates G_i tons of garbage. All communities pay a fee to the host community of a per ton, where $a \sum_{j=1}^{n} G_j = C_k$. Then community i's tax share is simply their fraction of the total garbage: $\tau_i = G_i / \sum_{j=1}^{n} G_j$.

The project is "all or nothing," so that within each community, either all of the trash is removed or none of it is removed. The net benefit to community $i \neq k$, a non-host, of the project (net of the reversion) is $z_i - \tau_i C_k - r_i$, and the net benefit to community k, the host, of the project (net of the reversion) is $z_k - r_k - y_k + C_k(1-\tau_k)$. The most *efficient* site is that community k^* which maximizes total net benefits: $k^* = \underset{k}{argmax} \left\{ \sum_{i=1}^{n} (z_i - t_i C_k - r_i) + C_k - y_k \right\} = \underset{k}{argmin}\{y_k\} = n$. Since the gross benefits (net of reversion) do not depend upon which community hosts the landfill, the community with the lowest total cost (including that community's valuation of the negative externalities) is the most efficient site.

3. Bargaining Power

A key concept of this paper is *bargaining power*: the ability to be the first to commit to a "final" offer and credibly refuse to bargain further with one or more other agents. This ability to commit is nontrivial: for example, a "final" offer C from a host to a firm may be substantially in excess of that host's costs, presenting potential opportunities for further bargaining. By committing to bargain no more, the host denies itself and the firm these opportunities and confronts the firm with a "take-it-or-leave-it" situation. On the other hand, this form of commitment is limited; agents cannot commit to arbitrary actions. The ability to be the first to make such a commitment is also

essential to possess bargaining power. For example, consider a two-player game in which both players have the ability to make "final" offers, but one of the players gets to make his final offer first. Then the power of the other player to make a "final" offer counts for nothing. Bargaining power, then, is possessed by that agent (if any) who is the first to make the last offer; by definition, there can be at most one such agent.

For simplicity, we restrict attention to two polar cases: either the potential host has bargaining power, or the siting institution has bargaining power.[10] We do not model the difficult and important question of how such bargaining power is acquired. The relevant institutions often assign bargaining power: if an agent is able to take a position via a costly action, which can only be undone by another costly action, the agent can thereby achieve bargaining power. For example, communities may be able to obtain bargaining power by adopting land use plans and zoning ordinances which are costly to revise. A legislature may be able to obtain bargaining power by embodying their site choice in legislation which is costly to revise. The focus of this paper is to demonstrate the importance of bargaining power, not to model how it arises.

The allocative and distributive impact of bargaining power will depend on the information structure. In the case at hand (trash disposal), costs y_i, benefits z_i, and the reversion outcome r are all likely to depend upon observable community characteristics, such as land values, income, population density and distribution, even community geology. We thus assume that all information is observable by all parties.[11]

3.1. Host Bargaining Power

Market Processes Assume that all agents (firm(s), communities) make offers and counter-offers of compensation to take landfills until there remains no mutually beneficial gains from trade. The firm(s) which secure landfills then sell trash collection services to all communities. If there are multiple firms, all have identical technologies; therefore, the firm that has secured the host with the lowest compensation gets all the business. Therefore, at most one landfill operates in equilibrium.

A salient feature of both competitive and monopoly market processes is that the outcome affects not only the "winner," but all other participants in the market, as they are taxed to pay the compensation to the chosen host (or pay for the compensation indirectly through their waste disposal fees). The winning community wants the highest possible compensation and all other communities want the lowest possible compensation (and therefore the lowest taxes or waste disposal fees). This important element of the NIMBY market is in sharp contrast to, say, an art auction, in which the losers are indifferent to the price paid by the winner.

Proposition 1. If information is observable and the potential host community has bargaining power, then either a competitive or monopoly market selects the efficient site with compensation $C_n = y_{n-1}$.

Proof: Community n's best offer is $C_n = y_{n-1}$; no other community can credibly underbid, as all would prefer to face the tax $\tau_i C_n$ than take the NIMBY at a cost $y_i - C'(1-\tau_i)$, for $C' < y_{n-1}$, $i=1,...,n-1$. The monopolist need not offer more than C_n, and offers of less would not be heeded. Community n's offer is lowest; any firm accepts it and the efficient site is the equilibrium outcome. ■

Intuitively, it is clear that neighborhood n prefers to bid y_{n-1}, and the discipline of the market prevents it from bidding higher. It is in the interest of all other neighborhoods to achieve the lowest possible bid from the winner, in order to minimize the resulting tax burden, so that some neighborhood $i \neq n$ may bid $C' < y_{n-1}$ in the hope that neighborhood n would be forced to underbid C'. However, since all information is observable, neighborhood n would realize that such a bid is not credible, in that it would be canceled if a firm accepted it. Therefore, neighborhood n need not underbid such a C'.

Legislative Process The legislature consists of representatives from every community; decisions are made by majority rule and are binding on all communities. Legislative decisions are made with *sophisticated voting over an endogenous agenda*[12] That is,

1. All communities take actions based on full knowledge of their consequences.
2. Any representative can make any proposal (consisting of a site i and compensation C_i) at any time; such a proposal is immediately voted against the current proposal, and the winner becomes the new current proposal. This continues until no more proposals are forthcoming.
3. If the current proposal defeats the reversion, it becomes the legislature's offer to the specified community.
4. If the legislature makes an offer to community k, then k can choose to veto the offer or accept it.
    i) If community k accepts the offer, the project is implemented with the site in k, with compensation C_k and taxes $\tau_i C_k$ for communities $i=1,2,...,n$.
    ii) If k vetoes the offer, the legislature makes an offer to another community, continuing until either some community has accepted an offer, or no community accepts an offer and there are no more motions forthcoming. In this last case the reversion R is implemented.

An *agenda* $\{(i,C_i), (j,C_j),..., R\}$ is a sequence of communities and compensations: first offer the site to community i with compensation C_i; if i turns it down, next offer the site to community j with compensation C_j; if j

turns it down,...., etc. If all communities turn it down, the reversion is implemented. The *equilibrium agenda* is the agenda that minimizes the total compensation the institution pays. The equilibrium agenda is assumed to be subject to the following:

A1 The m^{th} agenda alternative must be the institution's most preferred of the remaining alternatives (*subgame perfection*).

A2 The last alternative on all agendas is the reversion R ("*If all else fails*...").

We make the additional assumption that there are at least two host sites for which *every* community prefers at tax shares τ_i to the reversion:

$$z_i - r_i > \tau_i y_{n'}, \text{ for } n' < n \text{ and all } i. \qquad (1)$$

Note that this assumption is stronger than the existence of an efficient site; it states that there are at least two sites that, if priced at cost, could command a unanimous agreement versus the reversion.

Proposition 2: With host bargaining power, legislative siting with host veto results in the efficient site *n* being selected, with compensation $C_n = y_{n-1}$.

Proof: If presented with any offer $C' < y_{n-1}$, community *n* optimally vetoes the offer, and refuses to accept any compensation except $C \geq y_{n-1}$. It is clear that no community $i \neq n$ prefers to accept the site at $C' \leq y_{n-1}$, given the alternative of that *n* accepts the site at $C_n = y_{n-1}$. Hence the unique sophisticated voting, endogenous agenda equilibrium is the offer $C_n = y_{n-1}$ to community *n*, who accepts. ■

Intuitively, legislative siting under host veto shares the two key properties of market siting: (i) voluntary agreement by the host, and (ii) all non-hosts want to minimize the compensation paid to the host in equilibrium. Because there is only one legislature -- rather than many legislatures competing for the right to organize trash disposal -- the "demand-side" of the "market" with legislative siting under host veto is most analogous to the monopoly market siting described above. Similarly, endogeneity of the agenda (any community can make any proposal) is analogous to the "supply-side" competition between potential host communities in the case of market siting. It is these two properties, shared by both institutions, which leads to identical outcomes for both.

However, this "identical outcomes" result depends critically on inequality (1). If inequality (1) does not hold, siting by market process would always result in the efficient host being chosen, including the reversion if no host is efficient. However, this need not occur with legislative siting. In particular, (i) there is a project for which net

benefits (over the reversion) are positive in aggregate but not for a majority; or (ii) there is no project for which net benefits are positive in aggregate but they are positive for a majority. As an example of the latter, suppose a (bare) majority of communities receives most of the benefits from the project, but every community must pay any compensation according to their tax share τ_i. Then a project with negative net social benefit could be approved by this majority, effectively forcing the minority to subsidize the compensation cost. Intuitively, the problem arises because each community has a single vote in the legislature, but can "vote" with dollars in the market.

3.2. Institutional Bargaining Power

We now show that even with a voluntary agreement rule and supply-side competition, an inefficient host can result when the siting institution has bargaining power. For ease of exposition, we treat only the case in which the siting institution is a legislature; identical results obtain if the NIMBY is sited by a private monopolist (again, assuming inequality (1) holds). That is, suppose the legislature can make "take-it-or-leave-it" offers. This *institutional bargaining power* simultaneously permits the siting institution to *structure the alternatives available to a potential host, should it turn down an offer*, and to *make offers which drive any potential host to indifference against the equilibrium alternative*.

The ability to commit to no further bargaining with community i limits the institution to alternatives which are less attractive to both, but particularly to community i. Since it knows what the alternative is, and finds this alternative more unattractive than, say, the next cheapest site, community i is willing to accept less compensation to avoid this alternative.

More formally, the play of the game is as before, with the following additional assumption:

A3 The institution can commit not to bargain with a community that has refused an offer ("*take-it-or-leave-it*").

Suppose that the legislature offers community i the site with compensation C_i. Consider community i's decision; it rationally anticipates the remainder of the agenda and can determine the outcome if it refuses its offer of C_i: either some community h will accept with compensation C_h, or the reversion will occur. Therefore, community i will accept its offer iff:

$$C_i \geq \frac{y_i - (z_i - r_i)}{1-t_i}, \text{ if the reversion is the alternative, or}$$

$$C_i \geq \frac{y_i - t_i C_h}{1-t_i}, \text{ if community } h \text{ with compensation } C_h \text{ is the alternative.} \qquad (2)$$

The compensation-minimizing institution offers the minimum C_i consistent with (2). Thus. in contrast to the case with host bargaining power -- where the potential host obtains all quasi-rents between its site and the next-cheapest alternative -- with institutional bargaining power, the potential host can be driven to indifference against a

more costly alternative, thereby resulting in less compensation. In fact, with institutional bargaining power, host compensation is *always* less than its NIMBY cost:

Proposition 3. If a legislature with bargaining power is allocating the NIMBY, then the equilibrium host k's net (of taxes) compensation $C_k - \tau_k C_k$ is less than its NIMBY cost y_k.

Proof: Follows from (2); since $\tau_k C_h > 0$ and $z_k - r_k > 0$, $C_k - \tau_k C_k < y_k$. ■

Intuitively, when the institution has bargaining power, it can profitably structure the alternatives available to the equilibrium host and effectively strip the host of its quasi-rents. Since these quasi-rents are determined by the utility the host can obtain from the worst alternative the institution can credibly offer, equilibrium site selection is determined by the distribution of z_is, τ_i's, r_i's and y_i's.

Note that the ability to make "take-it-or-leave-it" offers permits the institution to gain by ruling out alternatives. For example, if the institution's agenda offers the least-cost community first, then the next agenda item (by A2) must be community $n - 1$, which may not be the most effective threat to community n. However, the institution can rule this out by making a "final" offer of, say, zero compensation) to community $n - 1$ before making an offer to community n. Since community $n - 1$ will not accept this offer, this rules it out of further consideration. If community n is offered second, it can be threatened with offering the NIMBY to community $n - 2$, the best of the remaining alternatives, a more effective threat than community $n - 1$. In fact, all communities can be ruled out in this fashion, so that community n can be threatened with the reversion. The agenda notation does not explicitly include the vacuous offers which are made simply to rule out certain alternatives.

We use the term "m-offer agenda" to refer to an agenda in which sites the number of sites that have not been ruled out is m (plus the reversion).

Proposition 4. If a legislature with bargaining power is allocating the NIMBY, then the equilibrium agenda has no more than two offers.

Proof: Let the agenda $A = \{(i,C_i), (j,C_j), R\}$ minimize compensation $C = C_i = \frac{y_j - \tau_i C_j}{1-\tau_i}$ over all two-offer agendas. Therefore, C_j must be the maximal threat against community i. Inserting the subagenda A' after j, $\{(i,C_i), (j,C_j), \{A'\}, R\}$, yields lower compensation only if it increases C_j. However, the agenda $\{(j,C_j), \{A'\}, R\}$ must be subgame perfect, and therefore can only decrease C_j. Since agendas of more than two offers can only increase compensation, they cannot be equilibrium outcomes ■

The intuition behind this result is straightforward: in equilibrium, the institution optimally threatens the host with the largest credible tax bill possible, which comes from offering it to the most costly subgame perfect threat. Adding more alternatives must decrease the cost of this alternative, making the threat less dire, and thus requiring more compensation to the host.

In the case in which all communities realize the same net benefits and face the same tax share, the equilibrium agenda involves only a single offer, with the efficient site chosen.

Proposition 5. If (i) a legislature with bargaining power is allocating the NIMBY, and (ii) all communities have identical benefits and tax shares (z_i-r_i = z-r, and $\tau_i = \tau$), then the efficient site *n* is chosen by a one-offer agenda.

Proof: We first show that a one-offer agenda is optimal. Assume the contrary; in order for a two-offer agenda to be optimal for the institution, there must be at least one community *j* which finds the reversion to be less of a threat than a subgame perfect offer to another community *k*. Let C_j be the minimum compensation required relative to the reversion, and let C_j' be the compensation required relative to the alternative of community *k* accepting compensation C_k. Assume the proposition false; then for some *j*, $C_j > C_j'$.

$$C_j = \frac{y_j - (z-r)}{1-\tau} > \frac{y_j - \tau C_k}{1-\tau} = C_j'' \text{ , or } \tau C_k > z - r.$$

Thus, for *all* communities *i*, $\tau C_k > z - r$, and the tax bill for all communities exceeds their benefits net of the reversion. Therefore, offering the NIMBY to *k* with compensation C_k is not a credible threat against *j*, as all would prefer the reversion to (k, C_k), and the equilibrium involves a one-offer agenda. The legislature chooses as host

$$\underset{k}{argmin}\, C_k = \underset{k}{argmin}\, \frac{y_k - (z_k - r_k)}{1-t_k} = \underset{k}{argmin}\, \frac{y_k - (z-r)}{1-t} = n. \blacksquare$$

Since uniformity across communities ensures efficient site selection in a one-offer agenda, it is clear that with institutional bargaining power, inefficient site selection or multiple-offer agendas can only occur if communities are diverse in the benefits they derive from the project.

The following two examples illustrate how an institution can use its bargaining power and its agenda control to minimize the compensation paid to the host community, and how this power can lead to inefficient site choices.

Example 1

Community	$z_i - r_i$	y_i	τ_i
1	60	130	.333
2	77	120	.333
3	55	100	.333

In this example, the net benefits (192) exceed the cost of any of the sites, yet no community gets sufficient net benefit to take on the project without compensation ($z_i - r_i < y_i$). Consider first simple agendas: {(i,C_i), R}. The compensation each community requires if the reversion is the alternative is:

$C_1^R = \frac{130 - 60}{.67} = 105.00$	$C_2^R = \frac{120 - 77}{.67} = 64.50$	$C_3^R = \frac{100 - 55}{.67} = 67.50$

In this case, community 2 would be selected host, even though it is not the most efficient. The host is paid a total compensation of64.50 (compensation net of taxes is64.50 - 1/3(64.50) = 43.00), which is less than its NIMBY costs of 120.00.

Consider next two-offer agendas: {(i,C_i), (j,C_j), R}, and let C_i^j = minimum compensation required for community i if community j is the alternative: $C_i^j = \frac{y_i - \tau_i C_j^R}{1-\tau_i}$.

$C_1^2 = \frac{130 - 21.50}{.67} = 162.75$	$C_1^3 = \frac{130 - 22.50}{.67} = 161.25$
$C_2^1 = \frac{120 - 35.00}{.67} = 127.50$	$C_2^3 = \frac{120 - 22.50}{.67} = 146.25$
$C_3^1 = \frac{100 - 35.00}{.67} = 97.50$	$C_3^2 = \frac{100 - 25}{.67} = 117.75$

In this case, the one-offer agenda leads to the lowest compensation of64.50 for community 2; all two-offer agendas require more compensation.

However, modifying this example leads to different results; suppose that community 1's cost is175 rather than 130:

Example 2

Community	$z_i - r_i$	y_i	τ_i
1	60	175	.333
2	77	120	.333
3	55	100	.333

Compensation required against the reversion differ only for community 1:

$C_1^R = \frac{175 - 60}{0.67} = 172.50$,	$C_2^R = \frac{120 - 77}{0.67} = 64.50$	$C_3^R = \frac{100 - 55}{0.67} = 67.50$

As in Example 1, community 2 is the compensation-minimizing choice from one-offer agendas, with required compensation of 64.50. However, two-offer agendas lead to a different result:

$C_1^2 = \frac{175 - 22}{0.67} = 230.25$,	$C_1^3 = \frac{175 - 23}{.67} = 228.75$
$C_2^1 = \frac{120 - 57.50}{.67} = 93.75$,	$C_2^3 = \frac{120 - 22.50}{.67} = 146.25$
$C_3^1 = \frac{100 - 57.50}{.67} = 63.75$	$C_3^2 = \frac{100 - 21.50}{.67} = 117.75$

In this particular case (but not in general), the efficient site, community 3, is chosen. The agenda {(63.75), (1,172.50), R} is the optimal agenda for the institution. Note that community 3's tax bill, should community 1 accept the NIMBY, is greater than the benefits net of the reversion for community 3: $z_3 - r_3 = 55 < 57.50 = \tau_3 C_1^R$. This is a necessary condition in order that the minimum compensation is realized with an agenda of more than one offer.

The above examples illustrate that if bargaining power rests with a legislature, then (i) the host's NIMBY cost is greater than its net compensation; (ii) inefficient equilibria can result; and (ii) multiple-offer equilibria can result.

4. Decide and Announce

Now consider the case in which the legislature decides upon a site and the host community must take it. There are two subcases of interest: (i) the selected community is forced to accept the NIMBY ("Decide, Announce, Dump"); or (ii) the selected community may be able to pay some other community (in dollars or political favors) to accept the NIMBY ("Decide, Announce, Bargain").

In the case of Decide, Announce, Bargain, assume the legislature assigns the NIMBY to an arbitrary community *i*. This community's best strategy is to "sell" the NIMBY to the lowest bidder, just as would occur if community *i* were a private monopolist without bargaining power (see Kunreuther and Portney (1991) for a proposal to implement this procedure using a lottery). In this case, of course, the lowest bidder will be community *n*. Since the default option is that community *i* is host, it seems reasonable to assume that community *n* will have bargaining power in this case. Hence the results of Proposition 1 obtain: the efficient site *n* takes the NIMBY and community *i* pays compensation $C_n = y_{n-1}$ (which is assumed to be within community *i*'s budget set).

In the case of Decide, Announce, Dump, one might imagine that bargaining also takes place, but as the prelude to the legislative siting decision. If bargaining among communities in the legislature occurs on a cash basis, then we would expect that Decide, Announce, Dump, would produce the most efficient site, just like Decide, Announce, Bargain. Then net benefits to community $i \neq n$ are $z_i - r_i$ and net benefits to community *n* are $z_n - r_n - y_n$. Although legislative bargaining might be based on a non-monetary "currency" such as political favors or legislators' votes on other issues, the assumption of no externalities suggests that no community has an incentive to vote against any mutually beneficial trade between community *i* and community *n*. In this case, the legislature chooses community *n*, the most efficient site, as the host.

However, Decide and Announce need not lead to efficient site choices, since the institution does not require voluntary agreement. Since no compensation need be paid for any site, Decide, Announce, Dump lacks any formal mechanism that disciplines the majority not to select arbitrary sites. Nevertheless, the possibility of inefficient site choices under Decide and Announce does not affect the primary conclusions of the paper, as we now show.

5. Constitutional Choice of Allocation Institution

The discussion of the previous sections assumed that the institution for determining the financing and siting of the NIMBY is in place. Of course, the choice of institution generally precedes the need to actually allocate and

finance NIMBY projects. The choice of institution is determined in the constitutional stage, or *metagame*, defined as follows:

- The legislature (as previously defined) chooses among these options:
    - * legislative allocation:
        - -decide and announce
        - -host veto, host bargaining power
        - -host veto, with legislative bargaining power and agenda control
    - * market allocation:
        - -competitive
        - -monopoly, host bargaining power
        - -monopoly, with monopoly bargaining power and agenda control.
- Communities and their legislators know the *distribution* benefits and costs of the prospective NIMBY(s) $\{z_i, r_i, y_i, \tau_i\}$. Each community has a uniform prior distribution of its position in this distribution ("veil of ignorance[12]").
- All communities are risk averse, preferring smaller variance of outcome to larger, *ceteris paribus*.

Several results follow immediately from the definition of the metagame and the propositions of the previous section; we state these results without proof:

Result: Since all communities are in identical positions (and everyone knows this), all will vote alike so that decisions are unanimous.

Result: Allocation by monopoly market or by the legislature lead to identical results, and depend only upon which agent has bargaining power (Proposition 1 and Examples 1 and 2).

Result: Market competition leads to the same outcome as monopoly with host bargaining power (Propositions 1 and 2).

In order to focus more sharply on the role of variance in the metagame, we make the assumption that:

Net benefits (z_i - r_i) and tax rates (t_i) are identical for all communities. (A)

From Proposition 5, this assumption implies that the efficient site *n* is chosen for all institutions, with the possible exception of Decide and Announce. Of course, Examples 1 and 2 show that other distributions of net benefits and tax shares can lead to inefficient outcomes. However, this assumption permits us to focus on the *distribution* of the benefits of NIMBY projects that results from each of the alternative institutions, rather than on the *size* of the total benefits that results. In other words, given assumption (A), the institution chosen in the metagame under the veil of ignorance will minimize the variance of each individual community's payoffs.

In general, if compensation C is paid to the host, then the gamble that each community faces in the metagame is:

be host with probability $\frac{1}{n}$ and receive net benefit $z - r - y_n + C\left(\frac{n-1}{n}\right)$

be a non-host with probability $\left(\frac{n-1}{n}\right)$ and receive net benefit $z - r - \frac{C}{n}$.

The variance of this gamble is

$$\text{Var}(C) = \left(\frac{n-1}{n^2}\right)(C - y_n)^2 \qquad (3)$$

The next proposition compares the frequently used institution of Decide and Announce with that of host veto with legislative bargaining power. Despite the popularity of the Decide and Announce approach in practice, the next proposition demonstrates that Decide and Announce is *never* preferred at the constitutional stage.

Proposition 6. Institutional bargaining power is preferred by all to Decide and Announce.

Proof: With institutional bargaining power (M), the host receives r and non-hosts receive $z - \left(\frac{1}{n}\right)C = z - \frac{r-(z-y_n)}{n-1}$.

First, assume that Decide, Announce, Dump (D) leads to the efficient site choice, in which the host receives $z - \bar{n}\gamma$ and non-hosts received z. With Decide, Announce, Bargain (B), the eventual host receives $z + (y_{n-1}-y_n)$, the host first selected receives $z - y_{n-1}$, and all others receive z. Therefore,

$$\text{Var}(M) = \left(\frac{1}{n}\right)r^2 + \left(\frac{n-1}{n}\right)\left(z - \frac{r-(z-y_n)}{n-1}\right)^2$$

$$\text{Var}(D) = \left(\frac{1}{n}\right)(z - y_n)^2 + \left(\frac{n-1}{n}\right)z^2$$

$$\text{Var}(B) = \left(\frac{1}{n}\right)(z - y_{n-1})^2 + \left(\frac{1}{n}\right)(z + (y_{n-1}-y_n))^2 + \left(\frac{n-1}{n}\right)z^2$$

Since no community wants to undertake the project unilaterally, $z-\bar{n}\gamma < z-y_n < r$, so that

$$\text{Var}(B) > \text{Var}(D) > \text{Var}(M).$$

If inefficient sites can result from Decide, Announce, Dump, then the variance Var(D) is higher and the expected net benefit is lower than hypothesized above. ■

The intuition suggests that this result is far more general. With Decide and Announce, all costs are borne by a single agent. If "Dump," that agent is community n and the cost borne is $C = y_n$. If "Bargain," then community i bears the cost; if $i \neq n$, that cost is $C = y_{n-1}$, or if $i = n$, the cost is $C = y_n$. With institutional bargaining power (and at least one $\tau_i < 1$), the cost $C' < C$ is shared among more than one community. This constitutes "insurance" against being forced to absorb all the costs, and therefore results in lower variance. All communities prefer the lower variance

institutions in the metagame; therefore any institution in which the costs of the NIMBY are shared is preferred by all to either form of Decide and Announce.

Therefore, there are only two relevant alternatives at the metagame stage: (1) competition/monopoly with host bargaining power; and (2) monopoly, with monopoly bargaining power.

The first alternative results in compensation $C' = y_{n-1}$ and the second alternative results in compensation $C'' = \frac{y_n - (z-r)}{1-\tau} < y_n < C'$, assuming that the host community's alternative is the reversion r. Under either alternative, the mean net benefit from the NIMBY project is $z - r - \frac{y_n}{n}$.

The next result characterizes the choice between host bargaining power and institutional bargaining power. From this we obtain

Proposition 7. The outcome of the metagame is competitive/monopoly with host bargaining power iff $C' - y_n < y_n - C''$; otherwise the outcome is monopoly with institutional bargaining power and agenda control.

Proof: Since (i) all agents are risk averse, (ii) all have the same diffuse prior over their position in future NIMBYs; and (iii) the efficient site n is chosen with either institution, all communities prefer

$$\underset{C',C''}{argmin}\ \mathrm{Var}(C) = \begin{cases} C' & \text{if } C'-y_n < y_n-C'' \\ C'' & \text{otherwise} \end{cases}$$

which follows directly from equation (3). ■

Equation (3) shows that compensation $C = y_n$ is first best (minimum variance) and can be viewed as the benchmark. Each alternative in the metagame deviates from this benchmark; competition or host bargaining power yields excess returns (the quasi-rent $y_{n-1} - y_n$) to the host, so that $C' > y_n$. If one community has a much lower cost of hosting a NIMBY than the next best alternative, that community stands to gain a substantial windfall at the expense of the non-host communities. This results in a large *ex ante* variance of outcome with this institution. On the other hand, monopoly bargaining power drives the host to indifference against the reversion r_i, and so yields returns which are less than the benchmark $C'' < y_n$. If one community has a very bad reversion r_i, then host veto with monopoly bargaining power can lead to compensation levels substantially less than host costs, to the benefit of the non-host communities. This can also result in a large *ex ante* variance of outcome with this institution. The effect which is the lesser determines which institution is chosen. In either case, the intuition of Proposition 7 is clear: *the institution with the smaller deviation from the benchmark $C = y_n$ has the smaller variance and is preferred by all.*

6. Summary and Conclusions

There exists a wide variety of institutions for allocating NIMBYs among communities: competitive and monopoly markets, and voluntary and involuntary legislative allocations. Of the voluntary institutions (markets and host veto), we have shown that the critical determinant of the efficiency of the outcome is not market vs. government, but which agent has the bargaining power: host community or firm/legislature. If the host community has the bargaining power, then the efficient site is chosen and the host receives quasi-rents over and above the cost of the site. If the firm/legislature has the bargaining power, then (i) the host receives less than the cost of the site; (ii) the most efficient site need not be chosen; and (iii) the minimum compensation may be achieved by confronting the host with an endogenously determined agenda.

The strong conclusion of the paper that it is bargaining power, not market vs. government, that matters. This conclusion of indifference between market and government must be tempered by noting that this depends critically on inequality (1): all communities prefer at least two sites to the reversion. If this assumption is abandoned, then markets still lead to efficient outcomes, but government need not. Thus, we are no longer indifferent between markets and governments on efficiency grounds, absent inequality (1).

The first sections of the paper focus on the efficiency of the NIMBY allocation under various institutions; the metagame analysis focuses on the endogenous choice of institution behind a "veil of ignorance," assuming efficient outcomes. Therefore the metagame context addresses distributive rather than efficiency issues. In the case of equal net benefits and tax rates, the institution which minimizes the deviation of returns to the host from the benchmark compensation ($C = y_n$) minimizes variance and thus is the unanimous choice. Perhaps most notable is the result that the involuntary institution of Decide and Announce is dominated by host veto with host bargaining power, despite the apparent popularity of Decide and Announce. The practical difficulties in siting landfills and nuclear waste repositories suggests that the involuntary mechanisms in use today are inappropriate policy vehicles, as indicated by the results of this paper.

If our finding is that Decide and Announce is always dominated at the constitutional stage by another institution, then why is it so popular as a practical matter? We conjecture that the disparity between fact and theory arises from our “veil of ignorance” assumption. In practice, political decisions regarding allocation institutions hardly take place in complete ignorance, but often (we conjecture) with substantial information about the likely outcome of any siting process. Since the objective of a majority of the legislature is to minimize compensation, this is best accomplished using Decide and Announce *if the outcome of the selection process is predictable at the constitutional*

stage. In fact, this appears to occur quite often in practice: the legislature/bureaucracy devises an elaborate (but arguably "fair") procedure to determine where the NIMBY is to be sited, and then plays "Decide, Announce, Dump."

Open issues remain, of course. In practice, disamenity spillovers from a host community to its neighbors appears important. In addition, the simplifying assumption of observable information seems counter to real-world situations in which communities are unlikely to know the costs and benefits of others. Therefore, private information may be the more realistic assumption. However, these potentially interesting extensions are beyond the scope of this paper, and must await further research.

-- References --

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-- Notes --

[1] See, for example, "Trash High, Taxes Low: Bucks town divided on landfill", *Philadelphia Inquirer*, Nov. 18, 1990, p. 1

[2] This terminology is related to (but not identical with) that of Kleindorfer and Kunreuther [1992].

[3] In some cases, the NIMBY may pose risks to the health of the current or future generations of residents. Many object to the notion of monetary compensation to a community that thereby increases its health risk, arguing that only the most desperate would sell off their own and their children's good health. Without coming to a judgment regarding the morality of this transaction, we assume that the noxious facility is to be operated and maintained to assure the health

-- Notes (cont'd) --

and safety of the surrounding community. The negative externalities generated by the facility are assumed to be non-life-threatening.

[4] The Nuclear Waste Repository Act of 1982 (U.S.C. §§ 10101-10226, 1982) granted potential host states the right to veto a proposed high-level nuclear waste repository within its borders, subject to override of the veto by both houses of Congress within sixty days. See Jacob (1990) for additional details.

[5] In practice, of course, communities consist of individual households whose views toward a NIMBY may be quite diverse. However, intra-community political processes are not the focus of this paper.

[6] In the case of hazardous NIMBYs, communities may have poor information regarding the risks to the community of accepting the NIMBY, and therefore underestimate their own y_i (although this lack of knowledge could as easily result in the overestimation of NIMBY costs). For some practical examples of this phenomenon, see Bailey, "Economics of Trash: Some Big Waste Firms Pay Some Tiny Towns Little for Dump Sites," *Wall Street Journal*, December 3, 1991, p. 1, The role of information in assessing a community's "true" y_i is very important, but not the focus of this paper. Each community is assumed to know its own y_i and acts accordingly.

[7] That is, if a landfill is located with a particular community, it is noxious to the residents of that community, but not to that township's neighbors. Indeed, if political boundaries are optimally drawn, this property might define a "community:" a land area/population that fully internalizes such externalities. In practice, this need not be true; a community could locate a landfill on its border with another community, thereby minimizing its impact on residents of the host but maximizing its impact on its neighboring community.

[8] If this assumption is relaxed, then full optimality can be obtained, both in allocating the NIMBY and in the constitutional choice of institution. If it is possible to design individually tailored payments for each community which depend upon preferences and costs, then net benefits can be equalized across all communities for each NIMBY. This "equal sharing" allocation rule always results in efficient sites and also results in minimum variance among communities. In practice, however, such individually tailored payments are not observed, as they are an obvious invitation to abuse. Fixed tax shares τ_i reduce this potential abuse, and are more likely to occur in practice. For this reason, we limit our attention in this paper to the fixed tax share case.

[9] This assumption reflects the focus of this paper on the *level* of compensation rather than the *distribution* of its costs to individual communities.

[10] It is easy to show that the case of no one having bargaining power is equivalent to host bargaining power.

-- Notes (cont'd) --

[11] Information is not necessarily contractible, in that although all parties “know” costs and benefits, it may not be possible to condition court-enforceable contracts on this knowledge.

[12] Endogenous agenda means that the order of voting is not prespecified, but is determined by the actions of the majority. See Austin-Smith (1987) or McKelvey (1986).

[13] Note that knowing either less or more in the metagame results in trivial outcomes. If *nothing* is known about prospective benefits and costs, then Proposition 10 implies that all communities prefer to postpone the metagame pending the receipt of more information. If *everything* is known about prospective benefits and costs, then a decisive coalition adopts "Decide and Announce" (in either version) and assigns the NIMBY as it chooses.