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A Marketable Permit Approach to Interstate Municipal Solid Waste Disposal

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Abstract

Municipal solid waste (MSW) landfills impose externalities on surrounding neighborhoods. Consequently, numerous laws have been enacted in order to promote a competitive interstate trade in MSW that takes such externalities into account. In principle, the externalities can be regulated via command-and-control of landfill technology and disposal practices; imposition of disposal taxes; or via a system of marketable disposal permits. While the law and economics literature gives consideration to the first two approaches, the latter marketable permit approach has not yet received attention. Nevertheless, the success of the U. S. SO_2 emission permit market suggests that such a mechanism could

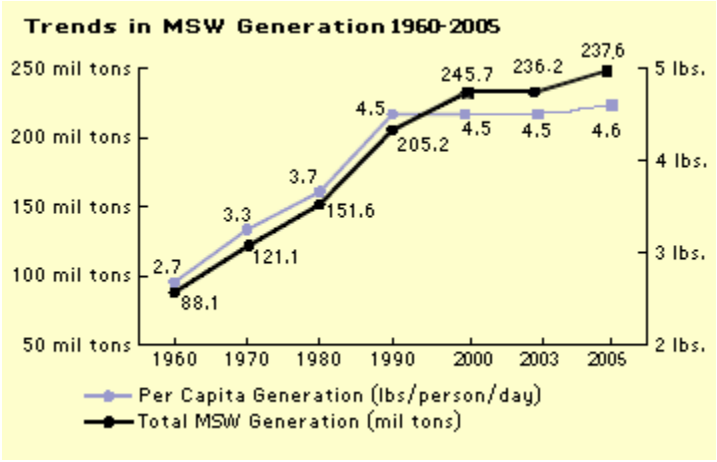
be effectively implemented to form an MSW disposal market among landfills. The purpose of this paper is to explore this possibility and lay the foundations for its implementation in the future. Along the way, consideration is given to debates within the U. S. Supreme Court as to the merits of promoting competitive interstate trade in MSW disposal. Also, the marketable disposal permit mechanism will be related to environmental economic literature regarding the merits of decentralizing environmental policy from federal to state responsibility. Lastly, the marketable permit idea is compared to a system of MSW disposal taxes as advocated most recently by Kinnaman (2006).

1. Introduction

As countries around the world have come to realize the need for a more effective way to control the extent to which we harm our environment, markets in which corporations are able to trade pollution disposal permits have become the cutting edge means of regulation. This marketable permit approach has been implemented in Europe and in the U.S., with the United States SO_2 market being one of the most successful disposable permit markets to date. With the thriving SO_2 market well on its way many are looking to use the marketable permit approach to efficiently decrease other negative externalities that damage our environment.

One area that could benefit from a marketable permit approach is municipal solid waste (MSW), more commonly known as household

garbage. Municipal solid waste consists of everyday items such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries (Environmental Protection Agency, EPA). The interstate trade of MSW has been regulated via command-and-control of landfills for decades. Since interstate trade of MSW falls under the Federal Interstate Commerce Clause, many rulings have been made by the Supreme Court in order to maintain the competitiveness and fairness of the MSW market. However, even with the current regulation that is in place, it is quite possible that a MSW disposal permit market would further the efficiency of the MSW interstate trade and decrease our negative impact on the environment dramatically.



2. Interstate Commerce and MSW Generation

The Interstate Commerce Clause was enacted in order to regulate intrastate activities that affect interstate commerce and which are economic or commercial in nature. The environmental commerce clause falls under the interstate commerce clause, focusing on federal and state

efforts to protect land and water (Klein, The Environmental Commerce Clause). Households throughout the U.S. pay for garbage collection and disposal services through some form of tax revenue. Because of this, they face a marginal cost (MC) of next to nothing for each additional bag of trash they throw away. Nonetheless, the MC of waste collection and disposal is greater than zero, thus allowing for an inefficiently large quantity of MSW to be generated (Palmer, Optimal Policies). In 2005, U.S. residents, businesses, and institutions produced more than 245 million tons of waste, which is approximately 4.5 pounds of waste per person per day. By looking at the trend graph from the Environmental Protection Agency's website, it is very clear that our waste generation per person has continued to grow over the years. (EPA)

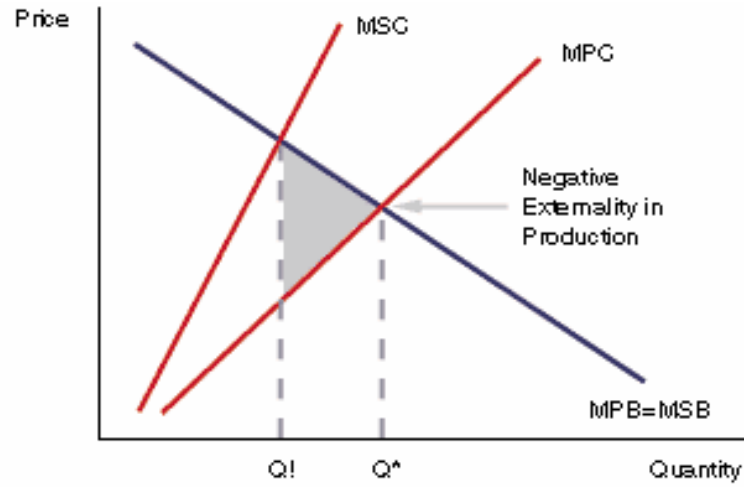
With the greater MSW generation there has been an increasing need for landfills in which to dispose of this waste. The number of landfills in the United States has been steadily decreasing from 8,000 landfills in 1988, to 1,654 landfills in 2005. Fortunately the capacity has remained relatively stable due to the old landfills being replaced by much larger landfills (EPA). However, in the very near future these landfills will not suffice and more will need to be built in the U. S in order to properly manage the MSW. Most people would agree that more landfills will be necessary, but the overall sentiment is that very few would vote to have a landfill built near their home. States have taken on a similar mindset to that of their constituents; they are exporting waste or restricting MSW imports in order to protect what untainted land and water remains in their jurisdiction. Studies show that there has been an increase in the amount

of MSW transported and disposed of out of state since the mid-1980's (Ley). The predicament that we are in is that under current policies we may expect MSW generation to steadily increase while distaste of landfills will continue. There are two options for resolving this problem. More communities will need to allow landfills to be built in their backyards, or those who generate MSW will need a very good (most likely financial) reason to abate their waste generation. And the former is a very difficult resolution to have come to fruition.

The siting process for MSW landfills is a lengthy one, taking on average five to eight years to complete. The lengthiness of the siting process is mainly due to the public's opposition to building a landfill in their community. This negative sentiment towards landfill siting has been coined, "Not in my backyard," or NIMBY (US Congress, USC). The general consensus is that landfills generate negative externalities in the community (Leigh). "Negative externalities result when part of the cost of producing a good or service is born by a firm or household other than the producer or purchaser" (Johnson). Garbage generating households do not internalize the environmental costs of disposing of their MSW in a landfill facility (Kinnaman). Therefore, the households and the facilities produce negative externalities, some of which are the potential health risks to residents from groundwater contamination and air pollution, the risk of methane gas explosions, and other environmental disamenities such as noise, truck traffic, odors and general unsightliness along with the potential to devalue property (Leigh, USC). Since landfills have a negative connotation, monetary compensation in the form of host fees are

sometimes used in order to sway opinions. Host fees are, "monetary compensation paid by municipal solid waste landfill operators to communities where landfills are located. Under certain conditions, a host fee can be interpreted as a measure of a community's willingness to accept (WTA) compensation from a landfill operator to offset the negative externalities imposed by a landfill" (Leigh). "Host fees may enhance the efficiency of siting decisions and thus vary according to the value of the negative externalities associated with the landfill" (Jenkins).

When there are producer induced negative externalities the marginal private cost (MPC), the cost to the firm, is lower than the marginal social cost (MSC), which is the cost to society. This situation is depicted in the graph below. As you can see by the shaded triangle, the greater the slope of the MSC is relative to the slope of the MPC, the larger the negative externality imposed on the environment (Bized).



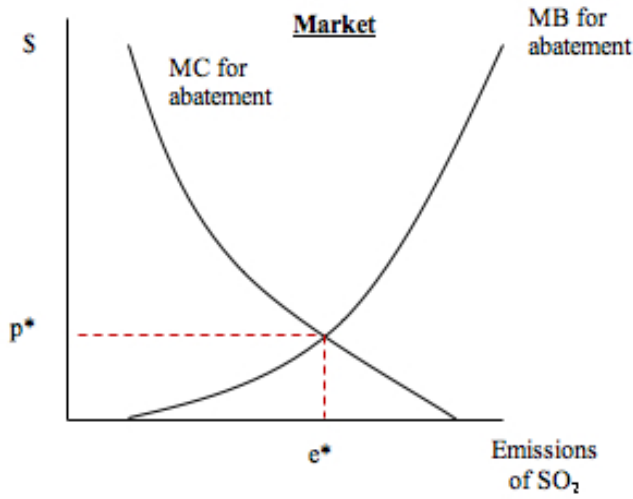
The government currently uses the Impact Pathway Approach (IPA) in order to monetize the negative impacts emissions have on their surrounding environments; this would be the shaded triangle in the graph. This methodology has four specific steps, emissions, dispersion, impact, and costs. The first step analyzes the quantity of pollution emitted by the facilities. Then, an investigation of the dispersion is completed by calculating increased concentrations of pollution in the regions affected by the negative externalities. The impact utilizes the exposure-response function, which calculates the impact on the environment due to its increased exposure to pollution. Lastly, the impact is monetized. The IPA evaluates the monetary impact of all processes conducted by the facility in order to result in the most accurate and thorough evaluation of the negative externalities possible (Borysiewicz). Based on the economic literature, an IPA format is practicable for an MSW disposable permit market also. Using this process in the context of an MSW market would lead to an estimation of a marginal private cost, MPC, of disposal function and a marginal social cost, MSC, of disposal function. Based on these curves the socially optimal taxes (or prices) and quantities of disposal could be determined. These quantities of disposal would represent the rates of waste accepted per landfill. From this acceptable rate of MSW, we could then quantify how many disposable permits should be issued in the disposable permit mechanism.

3. Economic Literature and MSW marketable permit

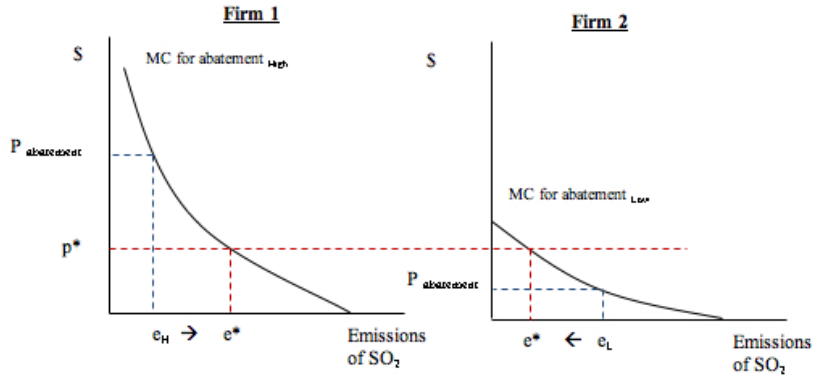
The U.S. EPA's SO_2 emissions permit mechanism can serve as a useful guideline in the design of an MSW disposal permit market. The SO_2 permit market uses a cap and trade method as a basis for the market structure. The cap and trade system is a regulatory program under which the government would set a cap on the rate of emissions and then distribute the rights to allowed emissions (Climate Policy Center, CPC). Each firm receives e_t permits at the beginning of each period t. The firm can comply with the emissions goal either by abatement or by buying additional allowances at a price p^e within the permit market, where the firm is a price taker. If the firm's emissions are lower than the permit allocation, the firm can then sell its excess permits in the permit market (Sterner). When there are externalities, an imposed cap on the total amount or rate of MSW that can be disposed at each facility can be beneficial. Along with the cap on generated MSW, MSW reduction targets could be implemented to ease the nation into further abating their MSW generation over a period of time. Care must be taken when setting the target for the MSW reduction. If the reduction target is too aggressive it can slow economic growth, have a negative impact on employment levels, and decrease overall investment, all of which would be imperative during the transition to a society in which less MSW is generated.

Currently, the most common way of regulating the environment is known as the "command and control" approach. This method is inefficient because it forces firms to divide the burden of pollution abatement equally amongst themselves, regardless of the cost of

abatement for each individual firm (Stavins). The reason that the marketable permit approach works so effectively is due to the fact that society's net benefit is maximized when the marginal cost of abatement at each of the facilities equals the marginal benefit of abatement. Ultimately, the goal is to drive down the MC for abatement function as much as possible. If the price of inputs decreases and there is increased innovation in the area of decreasing negative environmental impacts, the MC for abatement function will shift downward. With this mechanism, it is possible for each firm to reduce its emissions by a different amount, thereby making the permit system easily manageable when dealing with a large quantity of diverse firms. The cost of abatement for each individual firm will vary for numerous reasons; therefore, an incentive to trade permits exists between firms until their marginal abatement costs are equal (Burtraw). This is shown in the graphs below.



In the following graph, e* represents the total number of permits that would be distributed among the firms in the SO_2 permit market. P* thus represents the market price at which each permit would be bought or sold. This equilibrium price, p*, is then used by each individual firm to decide if it would be more beneficial for the firm to abate their SO_2 emissions or to purchase permits from the SO_2 disposable permit market. This concept is shown in the graphs below, which depicts two firms, Firm 1 and Firm 2, with two different marginal cost of abatement functions.



Once the SO_2 permit market is implemented, the equilibrium emissions price of the entire market determines the equilibrium emissions quantity, e*, for both firms. In the graph of Firm 1 we have a high MC for abatement and a starting quantity of emissions of e_H. Since the

quantity of e* is larger than e_H Firm 1 would desire to move to that quantity e* by purchasing permits from the market, rather than abating their emissions. This is due to the fact that their current cost of abatement per one unit of emission is greater than the permit cost per one unit of emission. The opposite is the case for Firm 2. Firm 2 has a low MC for abatement and therefore wants to reduce their emissions to e* in order to sell their extra permits in the permit market. Firm 2 can make money by abating their current emissions since the cost to abate one unit of emission is less than the cost of one permit. As you can see, the price that each firm pays per unit of emission is the same, even though their MC for abatement functions and equilibrium quantities differ greatly. The flexibility this mechanism offers is one of its strongest assets.

Within the marketable permit approach there are many different avenues to take in order to tailor the regulation to fit the needs of the industry. Allowing firms to bank, or hold, their extra permits for future use is one option many permit markets have adopted. This has the effect of creating a floor on the price of the permits determined by expectations about the future (Kopp). The fixed amount of emissions with the fluctuating permit price is an important aspect of the cap and trade system (Burtraw). The permit market functions well as a means of environmental regulation because if firms do little abatement they would all bid for a

bigger share of the same amount of permits and the price of current permits would rise, thereby restoring incentives for abatement (Sterner).

Reduction targets give firms the incentive to plan for the future's stricter constraints , giving them reason to bank their permits instead of selling them at a price that is too low (Kopp). Banking also prevents unexpected price changes from year to year since the firms involved will all be aware of the level of scarcity of the disposal permits. Accordingly, each year, if firms are given the option to bank permits, the aggregate industry emissions will be equal to or less than the number of allowances allocated for that particular year plus the surplus accrued from the previous year. One major concern with the banking feature of the permit market is the possibility of a significant increase in emissions by firms after using the permits they had saved in their bank. The consequent rise in pollution by these firms would greatly go against the purpose of the disposable permit market (Burtraw). In the SO_2 permit market, however, there are daily limits on emissions regardless of how many permits a firm holds. This same regulation could be used in an MSW mechanism in order to prevent irregular increases in pollution.

The initial allocation of the disposal permits is another topic which has received much attention. When a cap and trade system is founded the permits are a new type of asset and these assets have value associated with them. Therefore, the initial allocation of permits is an allocation of wealth (Kopp). This feature leads firms to favor permits over taxes, and we can expect landfill facilities to favor this too. For the permit markets which have already been established the governments

have used free permit allocations, permit auctions, or a combination of the two for the initial permit allocation (Palmer). Freely allocating the disposal permits is seen as compensation for the cost firms will incur for making the necessary changes to their business in order to meet the new environmental regulations (Sterner). Nevertheless, many have strayed away from an initial permit allocation that is entirely free because the government forgoes the opportunity to raise revenues which could then be used for research initiatives, tax relief, or efficiency programs. The most common initial distribution is the combination of a free allocation and an auction of permits. The free allocation of permits is generally used to compensate those who would initially suffer if required to purchase the permits at an auction. The remaining firms would then purchase their permits at an auction, establishing the market price. Economists favor an auction approach because of the economic benefits it has to offer. If the revenues generated from the auctions were used to reduce taxes or fund research the efficiency gains are much greater than those of the free allocation method. With a free allocation only the industry involved in the permit market will initially gain, while with an auction the entire society can gain (Palmer). However, when there is strong political opposition to the environmental reforms, it may be necessary to use a free allocation in order to appease those who oppose the regulations (Sterner).

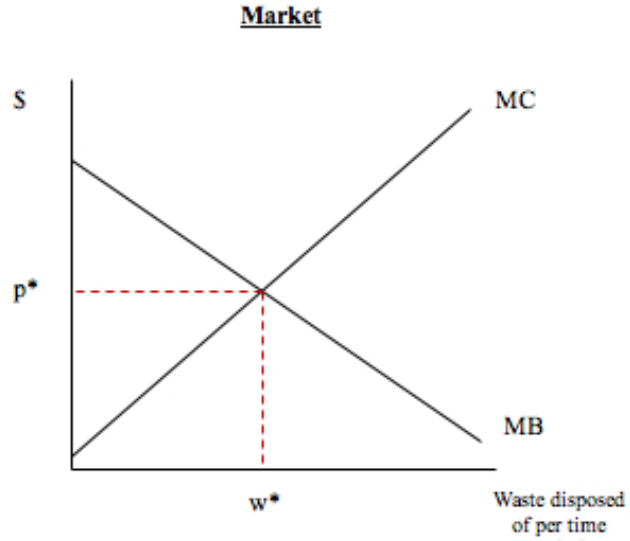
Using a permit market is a very cost effective method to regulate pollution. By using emissions trading the government entity would require little to no information from the individual firms because the permit market would, for the most part, manage itself (Burtraw). This

decentralizes the environmental policy significantly. Economists have found that cap and trade programs have such sizable cost savings because they provide incentives for the firms that can achieve the greatest pollution reductions at the lowest cost to do so. By not requiring every firm to reduce its pollution by the same amount the permit market equalizes the incremental amount that firms spend to reduce their pollution (Stavins). Studies of the SO_2 permit market have shown that the cap and trade system has saved the firms involved a generous amount compared to the command and control policies that were previously in place. However, studies have also shown that the permit markets have yet to achieve the maximum amount of cost savings that they can provide. This may be in part due to permit markets being such a new form of regulation (Burtraw).

If the United States implemented a disposal permit market for MSW among landfills we could greatly reduce our MSW generation. The decentralization of environmental policy could be very beneficial, helping to make communities become more aware of their impact on the environment and therefore encourage them to be more environmentally responsible. The most economically beneficial ways in which the government could organize the initial allocation is to either allocate the permits entirely through an auction or have an initial allocation that is part gratis and part auction. If the combination method is used, it would be necessary to establish a set a requirements that a landfill would have to meet in order to determine which landfills would not participate in the permit auction. In either case, the revenue generated from the auction

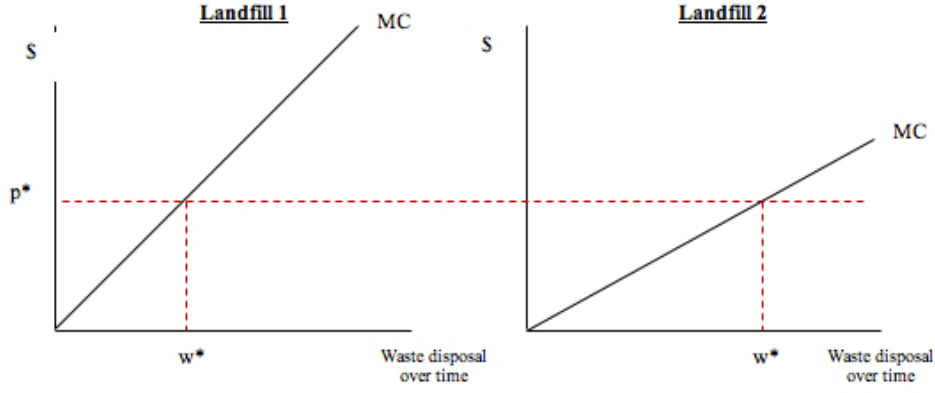
can be used to fund research for alternate forms of energy or as tax relief. Once the market is in place and each landfill facility has its allotment of permits, a garbage collection service would be implemented so that one or two individuals would pick up the MSW on a weekly basis, much similar to garbage collection services now. Then, the MSW would be transported to a hub which would serve as a median between the households and the landfill facilities. At the hub an employer would us a computer system to tell the worker at any moment where the MSW can be disposed of at the cheapest price. The computer system would also deplete the amount of MSW transferred to each facility from the landfill's permit account. Once the worker is told which landfill the MSW should be sent too, it is transported there and disposed of.

Applying gradually stricter MSW reduction targets would further help the country decrease its negative impact on the environment. We find the correct rate of disposal, the proper reduction target, for each period where MC(W) = MB(W). This is shown in the graph below.



The model of the U.S. MSW market is very similar to that of the SO_2 market's model. The equilibrium quantity, w*, represents the total amount of waste disposal in one time period, while p* is the corresponding price of each disposable permit for a unit of MSW. For each new time period of the MSW reduction policy the MC and MB functions would be derived and set equal to each other in order to find the cap on MSW generation and the consequent permit price. Currently, the SO_2 market policies would like to implement new reduction targets in the years 2020 and 2030. Communities would most likely not need as much time to decrease MSW generation as firms to decrease SO_2 generation since less technology is involved (Kopp). However, the SO_2 market's timeline for emissions reductions would be a suitable guideline for that of an MSW mechanism.

With the initial cap and the subsequent MSW reductions, communities would have the option to recycle as much as they would like in order to prevent the landfill facility from having to purchase more permits from the market. On the other hand, if the community so chooses, they could not recycle anything at all and the facility would then buy the necessary amount of permits from the market so they do not incur fines from the government. The waste generation of each community during one particular year will determine the cost of their disposal services for the subsequent year in the sense that if the landfill facility makes money through the sale of permits or loses money through the purchase of permits. This will act as an incentive for the community to generate less MSW. This works similarly to the SO2 permit market in which each firm abates their pollution to the extent that is best for them. The graphs of two landfills with differing MC functions are shown below.



As was true for the graphs of the SO2 disposable permit market and the two firms, p* was taken from the entire market and used by each individual facility to determine the e*. E* in the MSW disposable permit market's case represents the amount of MSW that each landfill would dispose of. In this case, Landfill 1 has a higher MC function than Landfill 2. Consequently, Landfill 1 would want to purchase permits from the market because it would cost less than it would to abate its MSW generation. Landfill 2, having the lower MC function, would sell its permits to Landfill 1 since abatement is the cheaper option for them.

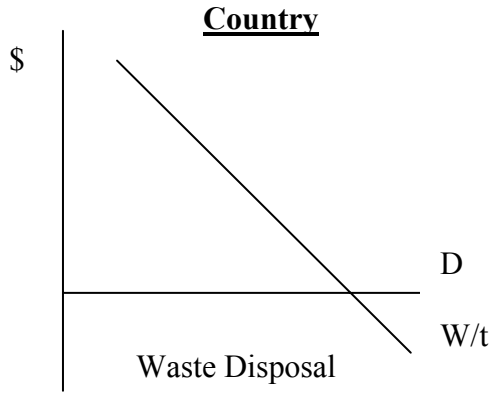
If an MSW permit market were to be put in place, the landfill facilities should be allowed to bank their excess permits at the end of each year. In the previous example, Landfill 2 would have the option of banking some or all of its excess permits. This would be an incentive for the communities to recycle enough to leave the landfills with extra permits at the end of each year, providing the facilities a cushion in case there is an unexpected increase in MSW generation the following year. It would also be best if the government put fines in place for the landfill facilities that exceed their allotments without purchasing extra permits from the market. This would help foster use of the market, assist in maintaining the market price of the disposal permits, and encourage recycling. A permit market system with realistic reduction targets would help reduce the amount of MSW generated in this country, thereby helping reduce the harm we inflict on the environment. If we begin to generate less garbage the need for more landfills will decrease and hopefully there will be less issues dealing with the exporting and importing of MSW between states.

4. Marketable Permits vs. Taxing

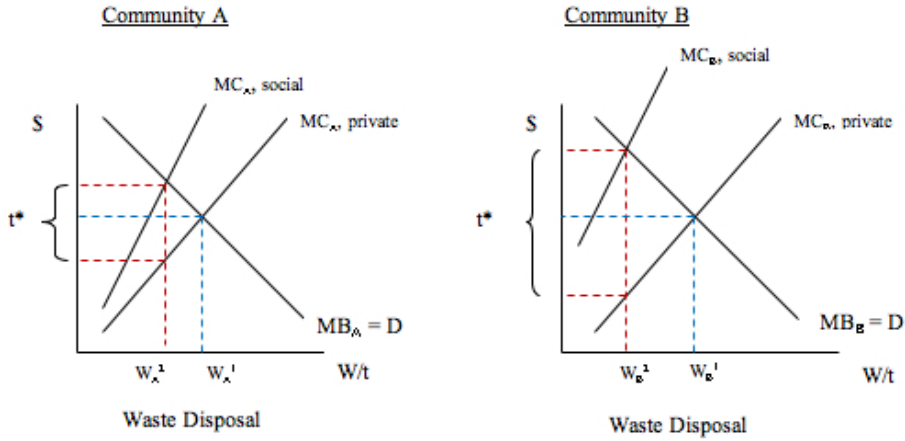
Numerous municipalities have levied taxes on the local landfills in place of a unit-based pricing program for curb side pick-up and recycling. Unit-based pricing is when a landfill facility charges a flat rate per bag, or container, of MSW collected. This mechanism has the potential to be efficient. Consequently, studies have shown that taxing, in any form, leads many households to dump illegally (Palmer, Optimal Pricing). Landfills that do not use unit-based pricing have internalized a portion of the environmental costs that they incur; however, these are largely internalized by charging higher tipping fees, or taxes based on tonnage. Currently, the Supreme Court feels that taxes, as long as they do not discriminate against certain waste, are sufficient in regulating the current MSW disposal (Kinnaman). Nevertheless, tipping fees do vary throughout the U.S. and thus impact the interstate flow of MSW dramatically. More MSW is transported to states with lower tipping fees causing more harm to the environments in the surrounding municipalities (Ley). A disposable permit market would rectify this congestion found in areas called "dumping grounds," because land, and thus MSW disposal, is the cheapest.

When determining the most favorable tipping fee for each landfill you are determining the equilibrium price of a depletable resource, the airspace available in the landfill. This is a fixed amount that will need to be replaced, by another landfill, when it has been used in its entirety. It is also important to note that, as the economy and the population of the

country grow, the demand for landfill space will continually increase. Thus, the supply of available land will decline, and its price will increase (Ready). The way in which landfill facilities determine their taxes, or tipping fees, is depicted in the graphs below. Suppose that, in the entire United States, we have only two communities with household waste to dispose of and each community has different technology, different environments, and thus different marginal benefit functions. We begin by looking at the entire country's demand curve for waste disposal.



Then, each community will have their own graph, with their individual marginal benefit (MB) and marginal cost (MC) functions. In this case we are defining waste disposal as a landfill facility which collects and then disposes of the waste. Also, the MB of waste disposal is the dollar amount of harm avoided by the people of the community from negative externalities such as poor groundwater, odor, visibility, etc. (Kinnaman).



In both communities we desire to maximize society's utility. Utility is defined as the benefits of waste disposal minus the costs of wastes disposal, or U(w) = B(w) – C(w). The graph for Community A depicts the equilibrium quantity of waste disposal when only the private costs are concerned to be W_A^1. However, when the social costs, due to the negative externalities from the MSW and the landfill, are added to the marginal cost function the equilibrium quantity of waste disposal decreases to W_A^2. Since social costs are not necessarily internalized by the landfill facility or society the government allows landfills to impose a tax on the waste they dispose of in order to recoup this social cost. The same happens in Community B when the social costs are added to the MC private function.

The greatest advantage of a permits mechanism versus taxes is that the landfill facilities would become an integral part of the mechanism with an asset (financial instrument) of value, rather than by new higher

taxes/fees. Communities that abate more waste will give the landfills the opportunity to sell their excess permits to others who don't and collect money. Constituents would like that opportunity. The mechanism is consistent with both sides of the Supreme Court battles and advances in informational technology are making these systems as easy to implement/run as the current method of taxes/fees.

Conclusion

The general consensus in the economic world is that permit markets are the most effective mechanism for achieving the greatest level of efficiency in an industry that generates a significant level of negative externalities. The permit market mechanism is still in its infant years, but there is great potential for this form of regulation. Its adaptability allows it to meet the needs of the industry in which the market will be regulating and then it allows the firms within the industry to also adjust accordingly.

It is evident from the SO_2 permit market that many firms favor the disposable permit market approach over taxes. With there being no evidence showing that landfill facilities wouldn't share this feeling, a more effective MSW disposal system should be applied to this industry also. The rate at which our country generates MSW is staggering. A permit market approach would do nothing but improve the current situation, and in turn make the interstate commerce of MSW disposal more efficient.

With the abatement in MSW generation and the increase in disposal efficiency throughout the country, the negative externalities that result from MSW generation and disposal would decrease. The exact

monetary benefits of a disposable permit market for MSW are not known; however, with the great success of the SO_2 disposable permit market it is quite likely that an MSW permit market would be successful also. And with this great success, the government would have more available funding to put towards programs that would further benefit our environment and our country.

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