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TIME TO TRASH GOVERNMENT INTERVENTION IN GARBAGE SERVICE

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Executive Summary

The necessity of government-managed garbage collection is grounded in the belief that economies of scale and collection route density result in the formation of service monopolies. The policy remedy is for government to induce competition through the use of franchise bidding in which private firms compete for the right to be geographic monopolists.

This study finds that economic criteria do not provide a rationale for government intervention. Economies of route density do exist, but they do not provide a rationale for the current structure of the refuse-collection industry. Both municipal and franchise contract services are found in dense settings, where competition is possible, and unregulated open competition can be found in less dense settings, where natural monopoly conditions should exist.

Even where natural monopolies exist, their pricing behavior is constrained because the entry and exit costs faced by potential competitors are not large. Instead, natural monopolies in refuse collection are contestable and therefore charge prices identical to those that result from bidding for exclusive franchise contracts.

The extent of government involvement currently found in refuse-collection markets is not justified by economic criteria. Accordingly, the decision about how often the garbage should be picked up, what kind of post-consumer materials (if any) should be collected for recycling, how nonrecycled waste should be disposed of, and how much should be paid for those services should be left to individual households.

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Introduction

How much should Americans recycle? What should we recycle? How can we most efficiently organize the collection of recyclables? And what should we do with our nonrecycled garbage--burn it, bury it, or compost it? Those questions and others surrounding municipal solid waste management have launched thousands of bureaucratic careers, dozens of successful environmental organizations, and a cottage industry of consultants who debate endlessly about how post-consumer materials can be most efficiently managed by government. Liberal and conservative policy analysts have argued about <u>how</u> government should manage waste, but the idea that government--not homeowners themselves--should make those decisions is rarely fundamentally questioned.

The necessity of government-managed garbage collection--and the related necessity for government to decide the terms and conditions of that service--are grounded in the belief that economies of scale and collection route density inevitably lead to the formation of service monopolies. The institutional remedy of choice is for government to induce competition through the use of franchise bidding in which private firms compete for the right to be geographic monopolists.[1]

This study examines the common wisdom regarding the necessity of government-managed garbage service and finds that economic criteria do not provide a rationale for government intervention. Economies of density do exist, but they do not provide a rationale for the current structure of the refuse-collection industry. Both municipal and franchise contract services are found in dense settings and unregulated open competition can be found in less dense settings, the exact opposite of what theory would predict. Economies disappear at sufficiently low density that unregulated two- and three-firm competition would be viable in dense urban settings. Even in those areas where densities are such that economies of scale prevent the normal efficiency results of competition, the natural monopolies that result are constrained in their pricing behavior because the entry and exit costs faced by potential competitors are not large. Instead, natural monopolies in refuse collection are contestable and therefore charge prices identical to those that result from bidding for exclusive franchise contracts. The extent of government involvement currently found in refuse-collection markets is simply not justified by economic criteria. Accordingly, the decision about how often the garbage should be picked up, what kind of post-consumer materials (if any) should be collected for recycling, how nonrecy-

cled waste should be disposed of, and how much should be paid for those services should be left to individual households.

The Economic Rationale of Government Garbage Collection

The justification for taking the decision about garbage service out of the hands of homeowners and placing it into the hands of state and local bureaucrats is largely based on the belief that the "naturally monopolistic" waste-hauling industry would exploit homeowners. The industry is commonly judged to be naturally monopolistic because of economies of density and scale. But, as we shall see, even if the diagnosis is correct, it does not necessarily follow that government control over the industry is warranted. Indeed, insights by economists suggest that, since the barriers to entry into the garbage collection business are so minimal, the threat of competition would protect consumers no matter how naturally monopolistic the business. Government control, therefore, is not necessary.

Economies of Density and Scale

Economies of density exist if the cost of garbage collection decreases (per pickup) as the distance between stops decreases.[2] Cost savings arise because the labor and capital (the truck) involved in collection spend less time between stops. As collection densities increase, time savings eventually reach a limit, and other congestion effects may make costs rise if density becomes too great. In our largest cities, for example, traffic congestion slows down collection.

If economies of density were large, costs would be lower if few rather than many firms collected all the trash. The more firms that share a collection route characterized by strong economies of density, the greater each firm's costs per pickup. "Natural monopoly" exists if one firm can service a route less expensively than multiple firms.

If costs vary with the number of firms in the industry, "destructive competition" is likely to occur. Companies in a multifirm market will set prices lower than the level that can return a profit because each hopes to capture the customer base that is the key to future profitability. In the short run, such tactics lose money, but if other firms declare bankruptcy first, in this game of

"chicken," the price-cutting strategy will lead to the survival of the firm.[3]

The analysis can be extended easily to economies of scale rather than density. If refuse collection is characterized by economies of scale, firms' costs per customer are reduced as firm size increases. Large firms serve additional customers at lower cost than small firms.

In a refuse-collection market with economies of density but no economies of scale, each collection route might be a natural monopoly but the refuse-collection industry would be composed of numerous small firms. In a refuse-collection market with economies of scale but no economies of density, a few large firms would compete successfully on every route. In a refuse-collection market characterized by both economies of scale and density, a few large firms would serve a large number of contiguous monopoly routes.

Remedies for "Imperfect" Garbage Collection Markets

The essential difficulty created by natural monopoly is that prices are higher than marginal costs and the quantity of services provided is less than it would be if prices were at marginal cost. Four strategies have been offered by scholars and utilized by governments to deal with monopoly.[4]

The first strategy is public ownership and operation. In theory, under this scheme, the public sector prices at marginal cost and subsidizes the difference between marginal and average cost with tax revenues. Despite the trend away from government ownership and operation of firms in the world economy, this is an important mode of intervention in residential refuse collection. In surveys conducted by the International City/County Management Association (ICMA), between 40 and 50 percent of all local governments in the United States supply refuse-collection services.[5]

The second option maintains private ownership but uses public subsidy generated through the tax system to cover the difference between marginal-cost pricing and total costs. Regulatory economists have developed schemes to implement such subsidies, but they have not been used in real-world situations and certainly not in residential refuse collection.[6]

The third strategy is traditional regulation by public commission, the purpose of which is to allow rates to cover costs with zero economic (excess) profits, although the prices charged would be higher than marginal cost. This type of intervention is the subject of considerable regulatory scholarship, most of it very critical,[7] but the relevance to refuse collection is minimal because very few localities have private residential refuse-collection companies that are regulated like other utilities, such as electricity and gas companies. An exception is the state of New Jersey, where a public utility commission regulated refuse-collection companies from 1970 until the early 1990s.[8]

The fourth policy option is the use of natural or induced competition to create the same outcome as that created by regulation: a set of prices that results in zero excess profits but avoids bankruptcy for the firm. Such competition transforms natural monopolies into what are known as contestable markets.[9]

A market is naturally contestable if entry and exit are relatively easy. In a naturally contestable monopoly, any attempt by the monopolist to raise prices above long-run average cost will result in economic (excess) profits. These profits, in turn, will result in entry by a competitor. Competition will reduce prices to average but not marginal costs because marginal-cost pricing would result in bankruptcy. In theory, the effects of contestability do not depend on actual competition. As long as a monopolist knows that prices above average cost will induce entry, he will price at average cost because pricing above average cost will create no benefits for the monopoly and potentially lead to a destructive game of chicken with new entrants.[10]

If a market with natural-monopoly characteristics is not easily contestable because of significant fixed-cost barriers that make the entry of new firms or exit without bankruptcy difficult, policymakers can achieve the desirable results of contestability through the use of franchise bidding in which competitors bid for the right to be a monopolist.[11] In this scenario, the bids consist of the set of prices to be charged rather than the sum of money bid in conventional auctions. With a sufficient number of bidders and reasonably frequent auctions for the renewal of the franchise, the prices charged by the winner will be average-cost (Ramsey) prices consistent with zero excess (economic) profits--the same result as with natural contestability and, in theory, regulation by commission.[12]

According to the 1995 ICMA survey, 37 percent of responding local governments in the United States have refuse-collection contracts with private firms.[13] Economists, for the most part, have not examined refuse collection since 1980, but the idea originally proposed by Chicago-school economists Harold Demsetz and Richard Posner to solve the problem of natural monopoly through franchise bidding has now become the conventional wisdom in refuse collection and, more generally, in public administration.[14] Enlightened public managers now believe in the necessity of contracting for services like refuse collection. Many local governments act on behalf of taxpayers to contract for the provision of local services at the lowest cost rather than providing the service directly.

While the shift from monopoly public operation of local services, like refuse collection, to franchise bidding is certainly to be commended, the existence of any governmental role at all presupposes a market in which natural-monopoly characteristics exist that cannot be controlled through natural contestability and whose costs are severe enough to warrant the benefits derived from franchise bidding of refuse collection. Such suppositions, however, are incorrect.

Economies of Scale and Density in Refuse Collection

The two best examinations of the economics of refuse collection are those by Young and by Kemper and Quigley. Young develops a model of collection costs and then generates predictions using reasonable estimates of tons collected per pickup, labor time per pickup, haul time to disposal, wage rates, interest rates, and truck life and costs. He concludes that refuse collection would exhibit economies of density up to about 1.6 tons per collection route mile, but that costs would not decrease very much at higher densities.[15]

Young argues that economies of scale cannot be examined directly because clear empirical evidence is not available, but he makes reasonable inferences given the number of firms of various sizes in the refuse-collection industry. In 1971, 57 percent of the firms had 3 or fewer trucks while only 16 percent had 10 trucks or more. Young concludes that economies of scale, if they exist, are small. Small and large firms have similar costs because they use different mixes of labor and capital.[16]

Kemper and Quigley examine actual collection data in Hartford and New Haven, Connecticut, to estimate the

effect of density on collection costs. Using time cards of employees, they determine the labor time and refuse collected on 519 route days in Hartford and 2,791 route days in New Haven.[17] Using data on reasonable labor and capital costs, they convert the time data into cost data.[18] Economies of density exist up to about 2 tons per collection route mile in New Haven and up to about 4 to 6 tons per collection route mile in Hartford.[19]

Kemper and Quigley qualify their results by suggesting that the economies of density observed in the data might be an artifact of the rigid work rules in Hartford and New Haven. All routes in the study have three-man crews; thus, the lowest density routes in each city probably are not collected in least-cost fashion. The least dense routes had higher than necessary costs because driving between stops is idle time for labor and driving between stops increases as collection density is reduced.[20] If one- or two-man crews were used, the economies of density would be less pronounced.

Kemper and Quigley examined data across cities and towns in Connecticut to gain additional insights into the issue of economies of density. These data are much less satisfactory than the Hartford and New Haven data because the measure of density is dwelling units per square mile rather than tons collected per pickup mile.[21] If the data from jurisdictions served by municipal service are combined with those from jurisdictions served by franchise contract and open-subscription private service, economies of density exist.[22] If the data from the three types of service are examined independently, however, no economies of density exist because private service is found in low-density situations, contract service in the middle, and municipal service in the highest density situations.[23]

Kemper and Quigley, like Young, do not examine data directly applicable to the existence of economies of scale. They argue that as long as the service population is large enough to fully utilize a truck, additional economies are unlikely to accrue to firms as they become larger than one truck.[24]

What is the importance of these findings? The importance of the existence of economies of route density depends on two factors:

- How dense is the collection rate on actual routes versus the point at which collection costs <u>do not</u> continue to decrease as density increases (economies of route density are exhausted)?

• Even if economies of density exist in the range of densities actually found on collection routes, and, thus, the routes are natural monopolies, are these routes easily contestable?

Each of these issues is examined below.

Collection Density

In their characterization of Hartford and New Haven results, Kemper and Quigley casually mention that the average collection route density in New Haven is about two tons per route mile while it is six tons per route mile in Hartford. Ironically, the average collection route density in both cities is also the point at which additional density provides little cost savings.[25]

These facts would seem to provide little support for the viability of multifirm competition. If customers chose firms randomly, the average route density for each firm would be the city average divided by the number of firms. So, for example, two firms competing in New Haven would reduce average route density to 1 ton per route mile, much less than the density at which economies are exhausted. For competition among three or four firms to be viable without natural-monopoly effects, average collection densities would have to be three or four times the density at which economies of density are exhausted. Hartford and New Haven do not fit that description.[26] A more likely scenario is effective competition in areas of greatest density and natural monopolies in areas of lower density.[27]

Consider the viability of open competition in U.S. refuse collection based on current census data. In 1994, the United States had 2.67 people per household and each person generated 4.4 pounds of waste per day, 60 percent of which was residential and 40 percent commercial.[28] At those rates, residential households would generate 49.3 pounds of refuse or 0.025 ton per week. With once-a-week collection, 65 households per collection route mile would generate enough refuse to reach the critical 1.6 tons per collection route mile at which economies of density are exhausted.[29]

What housing density would produce such collection density? In a hypothetical world with 1-acre zoning and square lots, refuse pickups would be 208.7 feet apart.[30] In such a world, one side of the street would generate approximately 25 pickups per mile.[31] With households on

Table 1
Effect of Household Density on Refuse-Collection Density with Once-a-Week Service

Housing Units per Acre	Distance between Collection Stops (ft.)	Collection Stops per Route Mile (both sides of street)	Residential[a] Rate (tons per route mile)	Commercial and Residential[b] Refuse (tons per route mile)
1	208.70	50.60	1.25	2.08
2	147.60	71.60	1.77	2.94
3	104.40	101.20	2.50	4.16
8	71.50	143.10	3.53	5.88
10	66.00	160.00	3.95	6.58
20	46.70	226.10	5.58	9.30
40	33.00	320.00	7.9	13.16

Source: Author's calculations (see text).
a. At 0.2467 ton per stop.
b. At 0.041 ton per stop.

either side of the street, each mile would yield 1.25 tons of refuse.[32] Notice that this is slightly less than the critical value of 1.6 tons cited by Young.

Table 1 displays data on the tons of refuse generated per collection route mile under the same assumptions for smaller lot sizes. As the table shows, only at densities above 8 units to the acre will collection densities be large enough for 2 firms to exist and yet both enjoy collection densities above 1.6 tons per mile. Only parts of New York City and Chicago have such densities.[33]

The final column in Table 1 presents a slightly different slant on the data by not distinguishing between residential and commercial refuse. The density of collection and thus the viability of competition rise under this assumption. But because commercial enterprises are not evenly located across space, the 4.4 pounds per person per day, which is the mean combined residential and commercial refuse production, is misleading for most routes. Nevertheless, the current distinction between commercial and residential refuse is artificial. If collection firms were free to combine commercial and residential collections to create greater collection density, they would do so.

Table 2
Population and Household Density, 1990

Jurisdiction	Population	No. of Occupied Housing Units	Area in Square Miles	Area in Acres	Population Density per Square Mile	Household Density per Acre
Washington, DC	606,900	249,634	61.4	39,296	9,884	6.4
Arlington County	170,897	7,520	26	16,640	6,573	4.7
Fairfax County	818,623	292,345	399	255,360	2,052	1.1
Manhattan	1,487,536	716,422	23	14,720	64,675	48.7
Queens	1,951,598	720,149	112.2	71,808	17,394	10
Cook County	5,105,044	1,79,482	954	610,560	5,351	3.1
Montgomery Cty	757,027	282,228	495	316,800	1,529	0.9

Source: 1990 Census of the United States.

How do the densities of actual U.S. jurisdictions compare with my hypothetical example? Table 2 provides population, household, and density information as of 1995 for Washington, D.C., and three suburban counties: Arlington County and Fairfax County, Virginia, and Montgomery County, Maryland. The boroughs of Manhattan and Queens in New York City and Cook County in Illinois provide some comparisons. Household densities range from just under 1 unit per acre in Montgomery County to just over 1 unit per acre in Fairfax County to 4.7 units per acre in Arlington County and 6.4 units per acre in the District of Columbia.

According to the economies-of-density paradigm, Fairfax and Montgomery Counties should have the most difficulty with a private market and Arlington County and the District of Columbia the least.[34] In fact, Fairfax County has a private market in most areas; Montgomery County has a private market in its least dense areas. Arlington County has 10 collection routes, 5 serviced through private contracts issued by the county and 5 serviced by the municipality. Washington, D.C., has exclusive municipal service.

An additional puzzle about Fairfax County is how it supports so many refuse firms (21 firms to be exact) given that its effective household density is just slightly greater than 1 household per acre, which generates collection densities of only 1.3 tons per mile with once-a-week pickup according to my optimistic calculations.[35] To be sure, the refuse generated by Fairfax residents would keep 101 trucks fully utilized for 52 weeks of the year[36]. But if all 21 firms competed on all collection routes, the effective collection densities would be so low as to preclude commercial viability.[37] How can an open-subscription system operate successfully in Fairfax County, as it has for decades?[38]

A defense of the viability of open competition in an unregulated refuse-collection market based on the actual relationship between economies of density and the size of the market is not consistent with the facts. In a hypothetical world in which land was fully utilized (no open space existed), household densities would have to be at least 10 to the acre for 2-firm competition to be viable and 40 to the acre for 4-firm competition to be viable, if the firms competed on the same routes and diluted the effective collection density. Such densities exist in some of our largest cities, but in the Washington, D.C., area as well as in a national random sample of jurisdictions, open-subscription service is found typically in lower rather than higher density areas predicted by the economies-of-density paradigm.[39] To justify as well as explain the viability and optimality of open competition in settings like Fairfax County, we must consider contestability.

How Contestability and Product Differentiation Alter the Picture

If economies of density in refuse markets create market failures, we would observe difficulties in the least dense areas and multifirm competition in the densest settings. Instead we observe the opposite. Open competition occurs with greater frequency in the least dense areas, whereas public intervention occurs in more dense areas.

How could the observed pattern of intervention be consistent with the economies-of-density market-failure paradigm? Dubin and Navarro claim that the decision to intervene in refuse collection markets has an ideological component. The greater the average percentage of votes cast for Democratic congressional candidates in a jurisdiction, the greater the probability of public intervention.[40]

But the discrepancy between marginal and average costs is real. The incentives for destructive competition created by the discrepancy cannot be made to disappear just because a jurisdiction is Republican, like Fairfax County.

A more satisfactory explanation would distinguish between contestable and entrenched natural monopolies. Remember that a natural monopoly exists in a market if economies of scale or density exist that create a discrepancy between average and marginal costs at the point at which market demand is satisfied. If two or more firms compete in such a market, prices will be higher than necessary and unstable. Under those circumstances competition will likely induce one or more of the firms to price at marginal costs. All firms will lose money with marginal-cost pricing. Some will go bankrupt. One firm will survive the game of chicken and become the monopolist.

How would the monopolist price its services? Contestability theorists argue that if entry and exist are easy, the monopolist will price at average cost because higher prices would create excess profits that would induce entry and the possibility of another round of destructive competition that the existing monopolist might lose. Average-cost pricing by the incumbent monopoly eliminates this possibility.

How contestable is refuse collection? The only capital requirement would seem to be a truck, and even that can be leased by the day, so a firm would not even have to find a week's worth of business to enter the industry.[41] The refuse industry, however, has not been studied for empirical evidence of contestability. Empirical tests have not supported contestability theory in other industries--the airline industry, for example--but the refuse-collection industry would seem to be the poster child for contestability theory, because it has none of the entry barriers found in the airline industry.[42]

In the context of refuse collection, contestability theory predicts the existence of stable monopolies if the effective collection density is less than 1.6 to 2 tons per route mile and stable multifirm competition at integral multiples like 4 (2 firms), 6 (3 firms), and 8 (4 firms) tons per route mile. Instead, in Fairfax County many firms have competed for service in a relatively stable fashion for a long period of time in much less dense settings. How is this possible?[43]

An important but never-stated assumption in the economies-of-density view of refuse collection is that peo-

ple's preferences for service as well as the services provided by companies are identical. If the preferences are not identical, then many firms can exist at collection densities that would normally lead to a natural-monopoly prediction. For example, if some people want daily service while others want once-a-week service and still others want twice-a-week service, separate firms can serve the same market even though effective route densities would appear to be much lower than those at which economies of density were exhausted.[44]

The existence of multiple refuse-collection firms at densities that would appear to be too low to allow the existence of stable competition is analogous to the existence of small convenience stores in close proximity to supermarkets or discount department stores. The apparent violation of economic theory by consumers who appear not to minimize costs when they buy from 7-Eleven rather than Wal-Mart disappears once one realizes that the convenience stores are not selling the same product as their competitors. What looks like multiple firms serving the same market is really multiple firms serving different markets. What would be puzzling would be the existence of 2 or 3 convenience markets in physical proximity to each other in a low density setting or 2 or 3 refuse-collection firms providing service of the same frequency, quality, and timing on one route that did not have 6 to 8 tons per mile of effective collection route density.[45]

How Does Recycling Change the Story?

Some policy analysts justify government intervention in refuse collection by invoking market-failure arguments in the collection of recyclables. Why don't free markets for recycling work? Well, in some circumstances they do.[46] Scrap yards, for example, recycle iron and steel. The growth segment in the U.S. steel industry is the so-called "minimill" whose raw material is recycled.[47] Recycling markets work fine in this sector of the economy because making steel from virgin iron and coal is more expensive than making it from recycled raw materials. In other areas of the economy involving glass, paper, and plastic, for example, the discrepancy between recycled and virgin prices often does not justify the development of markets for recycling.

Many argue that recycling is efficient and the continued use of virgin raw materials is not efficient, even in those markets in which recycling does not arise spontaneously through market forces, because both prices for

virgin materials as well as disposal costs for unrecycled products are artificially low. I will not address that argument, although the case against the optimality of disposal is more difficult to make than most people commonly believe, and support for recycling is more religious than economic in nature.[48]

For the sake of discussion, assume that the market prices for virgin glass, paper, and plastic, as well as for the disposal of goods made from these materials, are "too low" and that government should mandate recycling. Should governments do anything more than such a mandate? Is there an economic rationale for the governmental operation of recycling collection efforts?

The answer to that question would be a paper identical to the one you have just read, with the word "recycling" substituted for the word "refuse." The economies-of-density and economies-of-scale arguments would be identical except that the effect of recycling is to dilute collection densities. The material that otherwise would be collected by one truck would now be split between two trucks. In addition, recycling collection takes longer because recyclables have to be sorted into separate paper, plastic, glass, and newsprint bins as they are placed into the truck.

The implication of lower collection densities is the existence of natural monopolies at higher refuse densities than those that are implied in this paper. But, as this paper has argued, the worst possible scenario is natural monopoly. And because such monopolies would be easily contested--and therefore price efficiently at average cost--no rationale for public intervention exists. In addition, the effective operation of the open-subscription system (which now includes recycling) in Fairfax County, Virginia, at densities less than the literature suggests are required for effective open competition, implies that the need for public intervention based simply on the economics of collection is vastly overstated.

But What about the Trucks?

Why do we observe intervention in dense settings even though open competition would be most viable there? Dubin and Navarro suggest rent-seeking behavior on the part of unions as well as ideology (Republican areas prefer free markets) as an explanation. Their study suggests that the percentage of the collection force that is unionized is significantly related to the probability of municipal serv-

ice.[49] In my discussions with members of the refuse-collection industry, however, the explanation most frequently offered for public-sector intervention (either municipal, contract, or franchise operation) was the public's desire to have only one truck come into their neighborhood once or twice a week and pick up all the refuse.

These concerns involve aesthetics as well as safety. Many people want to minimize the level of commercial traffic on residential streets. Garbage trucks are especially unwelcome because they are big and make noise. The issue of child safety is also a major factor in many people's preferences. In practice, these concerns provide political support for monopoly pickup over open competition. Sometimes the monopoly is created by the public sector, but private property owners' associations seem to be driven by the same concerns and prefer refuse collection by monopoly contract rather than open subscription.[50]

Under what circumstances, if any, do the preferences of those who want monopoly service for safety and aesthetic reasons trump the preferences of those who want individually obtained open-subscription service? How should those who value property rights and markets respond to these concerns?

Let me start with some reasonable working assumptions. First, the behavior of people affects their neighbors. These effects become greater (probably nonlinearly) with increased density. For example, junk cars on the lawn and garbage trucks in the street affect more people in a more immediate way in a dense urban setting rather than they do in a rural setting.

These effects are often called externalities, but the term is used too loosely in this context. The manner in which people use their land affects the people near them, but can these effects be resolved by contract, and do market prices reflect the existence or absence of such resolution? The answer is yes on both counts.

This Land Is Your Land, This Land Is My Land?

Garbage trucks picking up your waste at times and in ways that your neighbors do not like are analogous to the difficulties created by scrap yards, nuclear plants, and other locally undesirable land uses (LULUs). In all such cases, the manner in which land is used affects the welfare of nearby property owners. Need government do anything about LULUs?

A club (a property association, for example) that restricts the use of land by private contract considerably reduces the risk of locally undesirable land uses.[51] If people attempted to have their garbage collected by a firm of their choosing on land governed by a covenant that restricts refuse collection (to a monopoly provider selected by the property association) without the consent of the other members of the association (presumably in return for compensation), then the club could sue the offending owner for breach of contract and receive a financial settlement.

But such risk reduction is not free.[52] Land governed by such covenants would command a higher price for residential purposes because of both demand and supply characteristics. On the demand side, consumers are willing to pay more for protection against unwelcome land-use changes, like garbage trucks using their streets at all hours. On the supply side, the costs to the owner/developer of providing such protection are higher because of the cost of compensating existing neighbors for the reduction in their right to do anything they please with their land.

What about land currently used for residential purposes not governed by these covenants? Under such circumstances, the price of the parcel reflects the lack of control one has over one's neighbors' activities. That is, the price for land with no restrictions would be lower than the price for land that has restrictions to compensate the owners for the risk that LULUs, such as multiple refuse trucks in a neighborhood, might occur.[53] Thus, in the absence of a covenant, owners of land near a parcel that uses its own refuse services rather than cooperating with neighbors in a franchise monopoly are compensated ex ante by the market for such risks.

So the existence of open-subscription service in a dense neighborhood, with the greater number of refuse trucks that would inevitably result, is not an externality or a market failure. Many people, however, desire protection against LULUs, including the existence of open-subscription refuse service, but do not want to pay for that protection. They want to acquire land that is cheap because it has no protection against LULUs, and then change the rules of the game politically through the enactment of "zoning" or "environmental" legislation that bans LULUs without compensation to the landowners whose rights are changed.

Private vs. Public Prohibitions

Even though private covenants and public zoning rules both ban or prohibit activities, private prohibitions have desirable elements whereas public do not. Private covenants are efficient for two reasons. First, covenants may be changed with the consent of the affected homeowners in return for compensation. In contrast, public land-use changes occur through majority-rule decisions of legislatures or commissions without explicit monetary compensation. Second, even though gains to trade actually exist, transaction costs may impede market transactions. In such cases involving private prohibitions, breach of covenant followed by ex post payment (civil damages) will serve efficiency. In contrast, public prohibitions cannot be changed in return for compensation. The sovereign (or a group representing some abstract public interest) cannot be diverted from total enforcement of prohibitions. Thus, absolute prohibitions are much more dangerous in public than in private solutions.

People obey covenants if the lost profit from the restricted activity, in the case of firms (or the lost consumption value, in the case of citizens), is less than the damage inflicted by the activity. Breach of covenants occurs and is efficient for the economy under the opposite circumstances. The victims of breach will sue and be compensated for their damages, but the excess of increased profits (or consumption value) over damages ensures that the landowner undertaking the activity--in this case the selection of his own refuse collector--will end up with a net gain.

The consequences of public and private bans with regard to the transfer of wealth also differ. Public bans on activity transfer wealth from the owners of land who lose the right to an "undesirable" land use to the owners of land who wish to ban incompatible uses. In contrast, private bans do not transfer wealth because neighbors sign covenants that reduce the number of potential uses of land only in return for compensation.

Public land-use restrictions are popular because people desire protection against spillovers without having to compensate their neighbors for their loss of the right to use their land. But even though the governmental creation of environmental rights appears to be "free," all subsequent residents of an area governed by such rights will pay for the privileges created by the legislation just as if those privileges were privately created. That is because the protections are now part of the expectations

associated with the property, and those expectations have market value regardless of whether the initial "owners" paid for them or not.

Conclusion

Refuse-collection markets are subject to a high degree of intervention by local governments in the United States. Such intervention is usually explained and justified by the existence of market failures, particularly the presence of economies of route density and scale, which create natural monopolies. Economies of density are a fact of life in refuse collection, but economies of scale are not. The mere existence of economies of route density, however, does not imply the impossibility of optimal, privately operated refuse collection without two further pieces of evidence: the point, if any exists, at which economies of density stop and the relation of this point to actual collection densities observed in the real world.

Economies of density in refuse collection do not go on forever. Scholars' best estimate of the point at which they stop is somewhere between 1.6 and 2 tons per route mile. Back-of-the-envelope estimates suggest that such collection densities exist once household densities reach 2 units to the acre and that 2 firms could compete on every route once densities reach 8 units to the acre.

The good news is that most suburban and urban jurisdictions in the United States have average household densities greater than 2 units to the acre. The bad news is that very few have densities greater than 8 units to the acre. The implication is that most jurisdictions on average could support one to two competitors on every route, but no more, because effective collection densities would be reduced to a level that raises costs and creates opportunities for destructive competition. A more optimistic perspective would contend that effective competition could exist in the most dense areas of our metropolitan areas while natural monopolies would exist on all routes whose density was less than 1.6 to 2 tons per route mile.

The pattern of intervention by governments, however, is not consistent with the objective of managing the problems of natural monopoly. If natural monopoly were the market failure that resulted from economies of density, intervention would be required for the least dense refuse-collection routes. Instead, the pattern of intervention is the opposite. Open competition is found in less dense

areas, and municipal operation and franchise contracting are found in urban areas.

Government intervention is also not consistent with managing the problems of natural monopoly because contestable natural monopolies do not create the economic mischief that is usually attributed to them. Contestable natural monopolies price at average cost, the outcome that is the stated purpose of both public-utility-like rate regulation and franchise bidding. Refuse collection is an ideal contestable market. The mob in New York and New Jersey would be the first to testify that restrictions on entry into the industry are difficult to enforce without violence and fear. Thus, there is no need for explicit policy actions like municipal operation, franchise contracting, and public utility regulation even if "natural monopolies" are inevitable in waste hauling.

The desire of many people to restrict the number of commercial vehicles in their neighborhoods is the basis of the political support for the intervention of local governments in refuse collection. To be sure, one resident's desire to have his refuse collected in a manner different from other residents does have effects on those other residents. But such effects are not market failures. Land with restrictions on neighbors' behavior can be and is privately supplied.[54]

The demand for government to create refuse-collection monopolies does not arise from any economic necessity to do so. Instead, it arises from the motivation of majorities to alter the rights of minorities without their consent and without compensation. To be sure, the lack of choice in refuse collection is not what first comes to people's minds when they are asked to list those actions of government that unnecessarily constrain individuals' freedom to make contracts. Nevertheless, public-sector intervention in refuse collection is a classic example.

Government-directed garbage service is also made to order for those who believe that we should centrally manage post-consumer waste markets. After all, if government must decide for us who should collect our waste, then the terms and conditions of that service--and the ultimate allocation of post-consumer commodities--are legitimate matters of governmental concern.

State and local governments should turn over garbage collection and recycling programs to the free market. Let each household decide what services to purchase, and let them pay the bill directly for those choices. Let freely

negotiated contractual arrangements between households and waste haulers determine what is collected for recycling and where the nonrecyclable material should go.

Notes

1. See Peter Kemper and John M. Quigley, The Economics of Refuse Collection (Cambridge, Mass.: Ballinger Publishing Company, 1976), chapter 6; Dennis Young, How Shall We Collect The Garbage? (Washington: The Urban Institute, 1972); and E. S. Savas, The Organization and Efficiency of Solid Waste Collection (Lexington, Mass.: Lexington Books, 1977), chapter 8. Two studies that dissent from the view that market failures warrant public intervention are James T. Bennett and Manuel H. Johnson, "Public Versus Private Provision of Collective Goods: Garbage Collection Revisited," Public Choice 34 (1979): 55-63; and Thomas G. Cowing and Alphonse G. Holtmann, The Economics of Local Public Service Consolidation (Lexington, Mass.: Lexington Books, 1976), p. 129. To be fair to the authors who make pro-intervention arguments, the scholarship on contestable natural monopolies that forms the basis for an important line of argument used in this paper was developed since 1980.

2. See Theodore E. Keeler, Railroads, Freight, and Public Policy (Washington: The Brookings Institution, 1983), pp. 44-46, for a discussion of economies of route density in the context of railroads.

3. See Keeler, pp. 43-61, and Gabriel Kolko, Railroads and Regulation 1877-1916 (Princeton, N.J.: Princeton University Press, 1965).

4. See Kenneth E. Train, Optimal Regulation (Cambridge, Mass: M.I.T. Press, 1991), pp. xi-xiv.

5. Evelina R. Moulder, Public Works: Service Delivery Choices, Special Data Issue (Washington: ICMA, 1994), p. 2, table 1. Daniel R. Mullins and Chia-Yin Chou, "The Solid Waste Crisis: Is Recycling a Response?," 1997 Municipal Yearbook (Washington: ICMA, 1997), p. 17, table 3/1.

6. See Train, pp. 177-90. The essence of the subsidy schemes is to make the subsidy equal to all consumers' surplus. Since total surplus is maximized by prices that are equal to marginal cost, the monopoly will then set prices efficiently at marginal cost.

7. See Richard A. Posner, "Natural Monopoly and Its Regulation," Stanford Law Review 21 (February 1969): 548-643. For general reviews of the literature on regulated markets, see Alfred Kahn, The Economics of Regulation: Principles and Institutions (Cambridge, Mass.: M.I.T. Press, 1988); Sam Peltzman, "The Economic Theory of Regulation after a Decade of Deregulation," Brookings Papers on Economic Activity Microeconomics 1989: 1-59. Roger G. Noll, "Economic Perspectives on the Politics of Regulation," in Handbook of Industrial Organization, Volume II, ed. Richard Schmalensee and Robert D. Willig (New York: North-Holland and Elsevier Science Publishers, 1989), pp. 1254-87; Clifford Winston, "Economic Deregulation: Days of Reckoning," Journal of Economic Literature 31 (September 1993): 1263-89.

8. Rob Abbot, "Economic Regulation of Garbage Collection in New Jersey," unpublished manuscript on file with author.

9. See William J. Baumol, "Contestable Markets: An Uprising in the Theory of Industrial Structure," American Economic Review 72 (1982): 1-15; and William J. Baumol and John C. Panzer, Contestable Markets and the Theory of Industrial Structure (New York: Harcourt Brace Jovanovich, 1982).

10. The markups above marginal costs will vary among classes of consumers depending on the sensitivity of their demands to price. To the extent firms can distinguish among consumers, those who are price-sensitive will be charged the smallest markups and those who are price-insensitive will be charged the largest markups. Such departures from marginal-cost pricing are often called Ramsey prices after Frank Ramsey, who first discussed the issue in 1927. Ramsey prices are also often called second-best prices. They are higher than marginal-cost or first-best prices, but they are optimal because they minimize the efficiency costs of raising the revenue to prevent the bankruptcy that would occur with marginal-cost pricing. See William Baumol and David Bradford, "Optimal Departures from Marginal Cost Pricing," American Economic Review 60 (1970): 265-83. The arguments of Baumol and Bradford are equivalent to those made years ago by Frank Ramsey, "A Contribution to the Theory of Taxation," Economic Journal 37 (1927): 47-61.

11. Harold Demsetz, "Why Regulate Utilities?," Journal of Law and Economics 11 (1968): 55-65; and Richard Posner, "The Appropriate Scope of Regulation in the Cable Television Industry," Bell Journal of Economics and

Management Science 3 (1972): 98-129.

12. For a critique of Demsetz and Posner see Oliver E. Williamson, "Franchise Bidding for Natural Monopolies--in General and with Respect to CATV," Bell Journal of Economics and Management Science 7 (1976): 73-104.

13. Mullins and Chou, p. 17, table 3/1.

14. See Savas, 1977 and E. S. Savas, Privatizing the Public Sector (Chatham, N.J.: Chatham House Publishers, Inc., 1982).

15. Young, pp. 44-45.

16. Ibid., p. 47.

17. A route day is one collection route observed during one day of the year. A collection route observed for 5 days would contribute 5 route days of data to a study.

18. An important problem in the comparison of the costs of public and private refuse collection is the discrepancy between public- and private-sector accounting. Public-sector budgetary data on collection costs cannot be compared directly with data from private firms because the public-sector data do not include proper account of capital costs and property taxes not paid on municipal operations. Kemper and Quigley provide the only attempt in the literature to measure the discrepancy and adjust for it. Their estimate is that public-sector costs are from 3 to 40 percent lower than true economic costs.

19. Kemper and Quigley, p. 30.

20. Ibid., p. 37.

21. Kemper and Quigley, p. 37, demonstrate that the tons-per-square-mile measure of density will underestimate the existence of economies of density compared to the appropriate tons-per-route-mile measure. The highly cited study by E. S. Savas is flawed because the jurisdiction is the unit of analysis and the density measure is households per square mile. Dubin and Navarro also use the Savas data in their analysis. See Jeffrey A. Dubin and Peter Navarro, "How Markets for Impure Public Goods Organize: The Case of Household Refuse Collection," The Journal of Law, Economics, and Organization 4 (1988): 217-41.

22. Kemper and Quigley, pp. 36-38.

23. Ibid.

24. Ibid., p. 52.

25. Remember that crew-size rigidities may be responsible for the location of the inflection point in the economies of density for New Haven and Hartford.

26. The New Haven and Hartford data are based on crews of three. The high costs on less dense routes stem in part from those rigidities. If we take Young's figure of 1.6 tons per collection route mile as the point at which density economies are exhausted, then 2 firms could be competitive if average route density exceeded 3.2 tons and 3 firms if average route density exceeded 4.8 tons as it did in Hartford.

27. Young, p.47.

28. Population-per-household data are found in table 66 and refuse-collection data in table 380 in the 1996 edition of the Statistical Abstract of the United States (Washington: Government Printing Office, 1997). The 60% figure for the residential component of total refuse was provided by Charles Miller of the Environmental Industries Association in a phone conversation on March 31, 1997.

29. (4.4)(2.67)(0.6)(7) = 49.34 pounds per residential household per week or 0.02467 tons per household per week. With once-a-week service, 65 stops per collection route mile would generate 1.6 tons of refuse (1.6/0.02467 = 64.86).

30. An acre is 43,560 square feet or 208.7 feet by 208.7 feet if the lot is square. The scenario assumes that land is fully utilized and streets form a rectangular grid.

31. 5,280 feet in a mile divided by 208.7 feet between households equals 25.3 households (pickups) per linear mile.

32. (50 households per mile) (0.025 ton per household) = 1.25 tons.

33. Manhattan has approximately 48 units to the acre. Queens has approximately 10, and Cook County, Illinois, has only 3 because it includes suburbs as well as Chicago.

34. The average density of Montgomery County is somewhat misleading because the northern half of the county is very

rural with extensive farming, whereas the southern half of the county is urbanized.

35. The list of refuse firms supplied by Fairfax County consists of 38 firms, 21 of which serve residential customers according to phone conversations in June 1997.

36. Kemper and Quigley (p. 52) claim that a fully utilized truck can collect 15 tons per day. Using the Environmental Protection Agency estimate of 4.4 pounds per person per day, 60 percent of which is residential, produces an estimate of 8,117 people necessary to fully utilize a refuse truck that picks up residential garbage 5 days a week.

37. As I state in the microeconomic theory section, if economies of scale do not exist but economies of density do, the refuse industry would be composed of many small firms that did not compete head to head on identical routes. Our phone interviews of the refuse companies in Fairfax County confirmed that most companies only serve limited areas.

38. In 1979 Fairfax County was served by 29 refuse firms that charged an average of $85.76 a year compared with $86.00 per year charged by the competing municipal service. In 1997 Fairfax County was served by 21 firms that charged an average of $252 a year for once-a-week service and $277 a year for twice-a-week service compared with $250 a year for once-a-week municipal service. See Bennett and Johnson for the 1979 data. The 1997 data are from a survey (conducted by Andrew Brunner, a Cato Institute research assistant) of firms listed by the Fairfax County Department of Public Works as providing refuse service.

39. See Dubin and Navarro, p. 228.

40. Ibid., p. 228.

41. To be sure, Environmental Protection Agency and other regulatory permits raise the fixed costs of entry.

42. See Severin Borenstein, "The Evolution of U.S. Airline Competition," Journal of Economic Perspectives 6 (Spring 1992): 53-54.

43. Bennett and Johnson (p. 61) raise the possibility that consumers are not very well informed about the costs and benefits of various refuse-collection options.

44. Notice also that if people who live near one another do not have identical preferences, the economies of density that arise if everyone's refuse is collected on the same day at the same time do not exist.

45. A final possible explanation of how open competition can effectively operate in relatively low-density Fairfax County is that the 1.6- to 2-tons-per-route-mile figure for the exhaustion of economies of route density is incorrect and the true figure is much lower. However, in a phone survey of refuse companies in Fairfax County conducted in June 1997, 9 out of 13 companies that quoted rates over the phone were quite wiling to give discounts of up to 60 percent for groups of contiguous households. This suggests that economies of density are not exhausted at the effective collection densities created by open competition in Fairfax County.

46. Pierre Desrochers, "Market Processes and Industrial Ecology: Theory and Historical Evidence," Journal of Industrial Ecology, in press (paper on file with the author).

47. Jonathan P. Hicks, "Making Steel Faster and Cheaper," New York Times, February 27, 1991, p. D7; and John Holusha, "Why American Steel Is Big Again," New York Times, July 21, 1994, p. C1.

48. See the discussion in Science about the relative costs of Styrofoam and paper cups: Martin B. Hocking, "Paper Versus Polystyrene: A Complex Choice," Science 251 (February 1, 1991): 504-5; and letters to the editor on the same topic in Science 252 (June 7, 1991): 1361-63. Also see John Tierney, "Recycling Is Garbage," New York Times Magazine June 30, 1996, pp. H24-H31. For a more comprehensive treatment, see A. Clark Wiseman, "Government and Recycling: Are We Promoting Waste?" Cato Journal 12 (Fall 1992): 443-59, and Grant Schuamburg Jr. and Katherine Doyle, "Wasting Resources to Reduce Waste: Recycling in New Jersey," Cato Institute Policy Analysis no. 202, January 26, 1994.

49. Dubin and Navarro, p. 229.

50. I have lived in two developments that were governed by property owners' associations. In both, all the other residents thought that monopoly contract was vastly preferable to open competition at the household level because open competition would involve multiple trucks in a resi-

dential area. To be sure, homeowner associations also solicit bids for monopoly service to avoid the transaction costs for homeowners to exploit the cost savings from economies of route density.

51. Undesirability is defined only in relational, not absolute, terms. Residential users may find warehouses an undesirable neighbor, but other warehouses would not. Mines are undesirable from a residential perspective, but a smelter might find a mine to be a very good neighbor. Research Triangle Park near Durham, North Carolina, is an example of a private industrial park that welcomes high-technology, non-smokestack industry but excludes traditional industry as well as retail, service, and residential uses because they are all undesirable from the high-tech tenants' point of view.

52. See William A. Fischel, The Economics of Zoning Laws (Baltimore: Johns Hopkins University Press, 1985), chapter 11, for a discussion of how zoning restrictions reduce the value of undeveloped land.

53. The lack of a control has both an up side and a down side. The up side is possible use of the land for commercial uses, which would raise the value. The down side is that the bids for continued residential use will decrease, a reflection of the relative undesirability of the land for residential use. See Richard Sansing and Peter M. VanDoren, "Escaping the Transitional Gains Trap," Journal of Policy Analysis and Management 13 (1994): 565-70.

54. See Bernard H. Siegan, Land Use without Zoning (Lexington, Mass.: Lexington Books, 1972).

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