Refusing to Contract and Contracting for Refuse;

Waste Collection Agreements in Cook County

MMSS Thesis – Northwestern University

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June 15, 2018
Refusing to Contract and Contracting for Refuse

Acknowledgments

I would like to thank Professor James Hornsten, of the Northwestern University Economics department, for providing support and guidance throughout my writing of this thesis. I would also like to thank Professor Joseph Ferrie and Nicole Schneider for directing me through the MMSS thesis process.
Summary

Refuse collection in Cook County is typically carried out through one of two avenues – competition between refuse disposal companies to serve individual households and a franchising contract between local government and the refuse disposal companies. It has been claimed that franchising provides benefits of cost efficiency through economies of contiguity. This paper examines how towns and villages benefit economically from franchising, and whether it might be possible to determine whether a town or village would likely benefit from franchising. We show that the data collected from the Illinois census and local budgets supports the claim that the main benefit of franchising comes from taking advantage of economies of contiguity and so is most productive in locations with high population density.
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Introduction

The necessity of refuse and recycling as a public good is unmistakable, as public sanitation is an ever-present concern to citizens and their representatives in government. Even when other societal goods like public parks, law enforcement, and education are shortchanged in the budget, refuse collection perseveres. This difference is due to fundamental differences between refuse collection and these other services. Refuse collection – or at least, its absence – has an immediate and clear impact on the quality of life for residents of the community. While not often a concern, when refuse collection is not up to par, there is a near-universal push by constituents (and probably not just a particular demographic) for government officials to resolve the problem.

This goes not only for residents of the community, but also for businesses that require commercial trash collection. In these cases, inadequate trash collection can deter customers, and potentially even risk the business failing completely. Of course, this varies with the business: a seafood restaurant is likely more anxious about its trash lying out for a few days than a bookstore. However, even the bookstore has boxes and wrappers that would eventually build up, accumulate, and take up valuable space.

As a result, it is important that local government be concerned about whether or not the residents and businesses under its jurisdiction are able to dispose of their waste. The problem that these governments must answer is how to ensure that the services provided by the trash collectors satisfy their customers. One facet of this problem is the question of whether the community should be serviced by a market of waste disposal companies competing to sign contracts with potential customers or by a single company franchise that is
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exclusively licensed by the local government to serve the community as a whole. This facet – the struggle between competition and exclusive rights – is that part of the waste disposal problem on which we will focus on in this paper.
Review of Literature

Savas, in his 1977 paper *An Empirical Study of Competition in Municipal Service Delivery*, acknowledged that the notion that competition for public services is beneficial to the “citizen-consumer” is theoretically sound (excepting in natural monopolies) but is sometimes viewed negatively by public servants, due to claims of difficulty of implementation, administrative burdens, and wasteful spending. He also noted that one example of these public services – refuse collection – is generally carried out under one of three competitive arrangements: permanent monopoly, temporary monopoly (e.g., exclusive contracts and franchises) and continuous competition. An example of a permanent monopoly would be municipal refuse collection, indefinitely serviced only by a public organization– this could arise either naturally, or by legal means. In contrast, the monopoly in the temporary case is legally maintained for a limited and pre-specified period.

Savas, among others, found that contract collection is less costly to households than a permanent monopoly, at least in cities with a population over 50,000. In addition, due to overlapping routes and competition for customers, continuous competition also leads to higher costs per household than the temporary monopoly system, due to “economies of contiguity” that result from having a single truck serve every house along its route – the alternative being inefficiencies from the redundancy of two or more different trucks servicing the same street.
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Figure 1. Economies of Contiguity (3-3)

Figure 2. Economies of Contiguity (5-1)
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As can be seen in both the figures above, if we consider a route made up of a number of locations that have to be visited with a specific starting and ending point (as might be required for a refuse collection route travelling through a neighborhood), there can be a substantial differences in total path length depending on whether there is a restriction on what locations can be travelled to in a given path. In Figure 1, two routes travelling to alternating locations (right) requires nearly double the total distance of a single truck moving to 6 locations (left). In Figure 2, even when the second route only needs to service a single location (right), the combined distance is still longer than that of the single-truck route (left).

Using this, Savas suggested that it would likely be best for cities to divide themselves into districts of greater than 50,000 people, assigning the temporary monopoly for each district through periodic competition. Realizing the potential of collusion, Savas also suggested that some districts be serviced by a public agency against which the private agencies are measured. While this may not be feasibly implemented in every city, it seems that those for which this is feasible would benefit from the process.

The case of Minneapolis in Savas’ paper happened to be a useful case study for this theory, as it was found that since competition for the temporary monopoly was introduced, cost per ton has been lower for the temporary monopoly collection than the “permanent monopoly” public collection. No apparent quality decrease was noticed between the two, though there was an upward trend for tons collected per shift for the municipal collectors. The conclusion that was drawn was that when the healthy competitive climate exists, the public benefits from open reporting of costs by the government and firms, greater productivity, and more cost-effective public services.
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Edwards and Stevens considered a number of alternatives to the traditional municipal service model in their 1978 paper entitled “The Provision of Municipal Sanitation Services by Private Firms: An Empirical Analysis of the Efficiency of Alternative Market Structures and Regulatory Arrangements.” By considering the quantity of service demanded, and regressing upon functions of factors such as total income of the area, size of firms by number of trucks, price of self-hauling, cost of capital, and household density, they hoped to determine the point at which government intervention in the form of municipal waste collection was preferable to the competitive environment.

They found that price regulation by the city (capping the price charged to individual households) had little effect, while making the services mandatory for all residents of the city lowered the price. This could be due to the economies of contiguity which Savas described, although Edwards and Stevens found that the collection prices were not affected by competitive bidding. Even so, they found that the price level differences between alternatives could not be solely explained by the fact that contracted collectors do not incur billing costs. The 41% savings experienced by contracted cities compared to non-contract cities is thereby attributed not to the bidding process, but the negotiation process that is prompted by the competitive environment.

McDavid’s 1985 paper “The Canadian Experience with Privatizing Residential Solid Waste Collection Services” reinforced the findings of Savas, as well as those of Edwards and Stevens, as the results agreed that private contracting improved efficiency of refuse collection from the municipal waste collection system. They noted that the competitive elements tended to
force higher pricing, and suggested that an improvement to the competition could be the introduction of bids through the competitive tendering system.

In 1986, Domberger, Meadowcroft, and Thompson noted in their paper *Competitive Tendering and Efficiency: The Case of Refuse Collection* that local bodies of government in England and Wales had issued formal tenders for refuse collection services. These tenders invited bids from local firms to compete for local services. Many of these tenders led to exclusive contracts being awarded to private contractors, allowing for records which Domberger et al. leveraged in the study to compare both the costs and quality of refuse collection services between those subject to the tendering process and those who were not.

Arguments for implementation of this tendering is that it has more efficient performance than refuse collection in a non-competitive setting. While private provision of tenders limits the level at which public authorities might regulate aspects like employment and price, it also removes some firm incentives that would exist in a competitive market, like an efficient use of city resources (to ensure that savings are passed onto residents) and cost minimization. In the best case, a competitive tendering process is effective because it encourages operators to reveal their relative efficiency to the local government, while also encouraging them to remain efficient after the fixed-price contract is implemented. However, this competition might be only superficial, and failure in the tendering process might reduce or eliminate completely the benefits if the private operator renegotiates the contract or lowers service quality opportunistically.

The authors were aware that competitive tendering is a significant part of local authority’s policies to promote efficiency, and so chose to examine whether or not it proved
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effective. As cost reduction was the suspected main benefit of tendering, and opponents of tendering accused the system of lowering value through worse service, Domberger et al. decided to focus on cost reduction and service quality as the two main points of study. They found that areas for which tendering was introduced have significantly lower costs after adjusting for other differences between the areas, without any apparent deterioration in service quality to residents.

Furthermore, Domberger and Jensen found in their 1997 paper “Contracting out by the Public Sector: Theory, Evidence, Prospects” that contracting is a widely used mechanism to reform public services through competition, specifically competitive tendering. Indeed, it seems that substantial savings can be garnered through such a method without sacrificing service quality, particularly for contracts at the local government level. They note that many public services have characteristics of a natural monopoly, which can allow the city to benefit from the competition for contracts without resulting in monopoly prices through the tendering process. In these cases, the market does not fail even if a given contract does (e.g. the firm does not supply the services that they promised), so a new contract can be tendered.

Domberger and Jensen also note that there may be concerns about the cost of contracting, which may be so high as to negate the benefits of the contract entirely. These costs are transaction costs – finding firms, evaluating and comparing offers, as well as communicating and negotiating contracts. It seems that, given the nature of the private contractor, they would be forced to pay costs of growth, service, and maintenance either way. In comparison, a public sector ownership of the refuse collection capital (e.g., specialized
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collection vehicles) has costs which no group would have an incentive to support, which is potentially problematic.

They therefore conclude that, theoretically, society would benefit from the contracting process when the competitive supply is large and quality that cannot be tied to contracts is less significant. When this is the case, the observed quality remains steady while savings are felt by all those involved.

This has a distinct similarity to the concept of Demsetz Franchise Bidding and the Demsetz auction. As Demsetz brings up in his 1968 paper Why Regulate Utilities?, cities can still take advantage of competitive pricing in the case of a natural monopoly by auctioning these franchises, formalizing the tender system through “franchise” contracts that they “bid” upon. This economic mechanism uses the auction framework to have the firms interested in providing refuse collection services compete – declaring lower “bids” for how much they are paid by the local government for the services than they would in a noncompetitive setting (specifically, closer to their cost of collection). They are then bound to charge this (lowest) cost for the duration of the contract. This helps avoid the challenges brought up by Savas in discussing the importance of competition for public services carried out by firms rather than the local government – namely, the deadweight loss arising from the government and residents paying a monopoly price rather than a competitive price.

As Demsetz argued, this is particularly useful in the case of natural monopolies, where (all else equal) it is inefficient for more than one company to service the region. A problem that would arise in these cases is that these natural monopolies have a tendency to charge monopoly prices – there is no one who can enter to compete the prices down, and so
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ey are incentivized to take advantage of their monopoly power. Demsetz used the example of public utilities in his paper to demonstrate this challenge and how it might be remedied. Here, the case for a natural monopoly is clear – the costs of laying additional wires or pipes across a region is far too high for a competitor to try and seize a share of the market from a hypothetical incumbent. Even if somehow more than one company had a position in the market, there is only room for one – and so it is most efficient for (either through mergers or leaving the market) only one firm to remain, providing its services.

The case in the refuse collection market is slightly different, hinging on the point that while there may not be a natural monopoly, the nature of economies of contiguity and limited refuse created ensures that only a few firms can feasibly compete – perhaps not enough to lower prices to a competitive level. The Demsetz auction solves this problem by forcing a competition between firms for the lowest “bid” price of refuse collection, so that they might receive the tender contract (and have any business at all). With sufficient firms competing in the contract (even if they could not all feasibly simultaneously compete in a contractless setting), the price is expected to be driven down to a competitive level. The firm that “wins” is then locked into that competitive price, ensuring that the local government and residents are paying the lowest costs until the next round of auctions, minimizing deadweight loss in the process.

This Demsetz auction also has the additional benefit of eliminating the need for transaction costs that might arise due to communicating with multiple firms, negotiating for the best price. In a Demsetz auction, the competitive nature of the auction accomplishes this “negotiation” as part of the auction process. This ensures that transaction costs are
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significantly reduced, further adding to the potential cost savings for the local government and the residents of the city so long as a good pool of firms bidding on the tendered contracts can be sustained to ensure that competitive forces remain active.

Methodology

We aim to estimate the chance that a given area will elect to utilize a franchise contracted refuse collection system by regressing in the form of a probit model, where the binary response variable $Y$ is 0 if the area does not utilize a franchise contract refuse collection and 1 if it does. In this probit regression:

The response variable (franchise status) will be regressed on six explanatory variables that we expect will play a role in determining whether an area chooses to utilize refuse collection, either by affecting firms’ cost of refuse collection or the amount of benefits the area’s residents and businesses would reap.

Four of the explanatory variables would be expected to produce efficiency changes in a contract system. Frequency of trash collection, amount of trash collected, cost per unit of refuse disposal, and population density are all anticipated to affect what Savas called “economies of contiguity.” We also include the variables of income per household and time. Income per household is included because it is expected to affect the demand for contracted refuse collection (due to increasing demand for services such as recycling), and time is included to identify if there is a general shift in contracted refuse collection from competitive bidding to franchising or vice versa.
The effects of some of these variables can be illustrated by an example of two cities: City A and City B. City A is heavily populated, resulting in significant crowding. City B is sparsely populated, but its residents are trying to maintain the city’s clean reputation, and so require frequent trash collection at a regular schedule.

In this case, City A would be interested in improving efficiency through economies of contiguity – reducing cost by limiting logistical overlap and wasted routes. As a result, it may find a contract collection system attractive, as it allows for a single firm to optimize their collection routes and take advantage of these economies of contiguity. City B may also be interested in a contract system, but for a different reason. It would not benefit from economies of contiguity so much as City A, but they may be interested in the consistency and public accountability of the contract system. However, City B would have to weigh this potential benefit against the potentially higher per-household cost of refuse collection than might be found in a collection system where firms continually compete for customers.

To clarify these differences, we move to explain the theoretical basis for each of these variables. We start by discussing those explanatory variables which we expect to affect the cost function – and consequently, the supply of firms willing to collect refuse.

We would suggest that frequency of trash collection would affect interest in a contract collection system because towns with residents and businesses that prefer more irregular trash collection would be more likely to favor a competitive system, as it allows for them to tailor the service to their need rather than being constrained by the citywide contract. Furthermore, it seems that more frequent trash collection would also lend itself to a competitive system, as it allows for more trips and routes for the companies to compete on,
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reducing the inefficiencies that would encourage firms to pursue economies of contiguity. A town with less frequent trash collection might be oversaturated in a competitive setting (too many companies competing for too few households), particularly if the one-company contract would provide service of sufficiently high quality.

For this reason, it also seems that the higher the amount of trash collected, the more an area might be more interested in a competitive system. With more room to compete, and reduced risk of an oversaturated environment, the logistical benefits of a contracted system are no longer as relevant. Clearly, cost of trash matters as well – it seems likely that a town with naturally lower costs of trash collection might be more interested in a continuously competitive environment that keeps prices down.

Firms would be less interested in providing service to a town that is farther away if they are only servicing a few customers. A competitive system implemented under these conditions may have higher costs resulting from a premium paid to encourage the firms to travel further. An area farther from the landfill might then be interested in the contracted collection system, as the contracted firm would now be motivated to travel extra distance to service a town with exclusively their customers, without having to compete with other firms. This would eliminate the need for a premium, and may even result in lower per-household prices for the contracted system than the competitive system.

There is also the consideration of population density, which is expected to increase the probability of an area utilizing the contracted collection system, due to economies of contiguity. A more densely populated area is likely to require more complex logistical issues when dealing with a variety of different companies. For example, overlapping collection
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routes of multiple companies may increase traffic and waste time and labor. By using a franchise, the city would allow a single company to optimize their route, without overlapping routes and extra trucks.

Furthermore, a more densely populated region is more likely to have a high cost of space. Residents of this region would then be more interested in minimizing the space taken up by a few companies’ half-full dumpsters, and choose a franchise system that would only require a single company’s service.

From a different point of view, we also examine income per household in the hope this will help describe the demand of a contracted collection system. This is because it seems that lower-income households would prefer the continuous competition system, as it allows for the customer to negotiate more directly with the trash collection agencies. Higher-income households who are more price-flexible may prefer the contracted system, as while it often costs more than the competitive system, it has a number of other quality-of-life benefits that a higher income household might believe to be worth the additional cost.

For one thing, it is easier for public officials to regulate a single firm than a group of them. A contracted system with a single firm would allow for more easily implemented restrictions on public concerns such as how many collection trucks can be on the road at once and how many emissions they can produce. In these contracted systems, the town is often also able to put a clause in the contract that requires the company to put out recycling bins or pursue other similar initiatives. Finally, the consistent service provided by a franchise might be desirable for an area that wishes to keep a clean image. These, among other concerns, might be more valuable to a higher-income neighborhood than the cost savings
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from a continuously competitive environment, while still capturing some savings that a municipal or monopolistic collection system would ignore.

Finally, it is possible that there is a general shift to the contract system over time. The potential benefits of a contract system are relatively recent findings, and it is possible that regions that would have benefitted from the process have been carried on by inertia or sticky regulations that have so far prevented a transition that they would otherwise like to pursue. As time passes, these regions may find the time to shift to the refuse collection system that they find preferable, rather than continuing a less efficient system out of habit.

We also will conduct a pair of linear regressions of refuse costs on multiple explanatory variables, including franchise status, to examine the efficiency of franchising from another perspective. One of these regressions will be regressing on refuse costs, while another will regress on refuse costs per capita. It should be expected that at the very least, the difference between the two should result in different interpretations of coefficients for explanatory variables such as Population and Population Density.

The economic interpretation of the coefficients in the linear regression will be similar to that of the probit regression, but viewed from a different perspective – noting the change in efficiency and costs due to the presence of a franchise or competitive system. This is contrasted with the probit interpretation which relates the likelihood of a franchise for a given town or village in Cook County to the explanatory variables. The former describes why a town or village may be participating in a franchise from a cost perspective, while the latter describes whether a town or village may be participating in a franchise.
Data

To collect data for this study, I collected data from towns and villages from across Cook County, Illinois. I primarily used the Illinois census to not only break down the county into five areas around the city of Chicago (North, Northwest, West, Southwest, and South) broken down by township, but also obtain values for population, population density, household income, and household size.

I then consulted the towns and villages individually, using publically available information on their website. This was not only to identify their waste hauler status, but also to go through their financial reports and historical budgets to determine their historical spending on refuse collection. This data was compiled across 131 towns and villages across 28 townships, with budgetary data tracked back up to 5 years historically (2013).

Table 1: Overall Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Population</th>
<th>Population Density (pop/mi^2)</th>
<th>Median HHI</th>
<th>Mean HHI</th>
<th>Mean HH Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEAN</td>
<td>20806.39</td>
<td>4302.09</td>
<td>$74,343.53</td>
<td>$98,368.97</td>
<td>2.73</td>
</tr>
<tr>
<td>MEDIAN</td>
<td>13821</td>
<td>4107</td>
<td>$61,441.00</td>
<td>$79,422.00</td>
<td>2.68</td>
</tr>
<tr>
<td>MAX</td>
<td>115908</td>
<td>14830</td>
<td>$200,001.00</td>
<td>$296,662.00</td>
<td>4.04</td>
</tr>
<tr>
<td>MIN</td>
<td>223</td>
<td>85</td>
<td>$25,390.00</td>
<td>$42,179.00</td>
<td>1.95</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>STDEV</th>
<th>20672.54</th>
<th>2751.63</th>
<th>$ 36,372.37</th>
<th>$ 52,525.94</th>
<th>0.340573</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTLIERS</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

(where outlier indicates a point more than two standard deviations away from the mean)

Table 2: Regional Characteristics

<table>
<thead>
<tr>
<th>Area</th>
<th>#</th>
<th>Mean Population</th>
<th>Population Density (per square mile)</th>
<th>Median Household Income</th>
<th>Mean Household Income</th>
<th>Mean Household Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>17</td>
<td>27,524.47</td>
<td>4132.00</td>
<td>$115,130.94</td>
<td>$161,704.00</td>
<td>2.70</td>
</tr>
<tr>
<td>NW</td>
<td>28</td>
<td>31,480.29</td>
<td>4,209.75</td>
<td>$83,207.68</td>
<td>$108,730.21</td>
<td>2.71</td>
</tr>
<tr>
<td>S</td>
<td>34</td>
<td>14,786.24</td>
<td>3,301.21</td>
<td>$52,467.50</td>
<td>$66,859.29</td>
<td>2.84</td>
</tr>
<tr>
<td>SW</td>
<td>19</td>
<td>16,860.53</td>
<td>4,498.37</td>
<td>$64,863.68</td>
<td>$83,028.11</td>
<td>2.55</td>
</tr>
<tr>
<td>W</td>
<td>31</td>
<td>16,502.52</td>
<td>5,456.23</td>
<td>$73,773.19</td>
<td>$98,239.77</td>
<td>2.74</td>
</tr>
</tbody>
</table>

After cleaning through the data, it was found that many of the towns and villages did not have sufficient records on the annualized cost of refuse collection or franchise status to assess. The most common reason for this was that refuse collection costs were bundled into other sections of their budget, without separation. For example, refuse collection costs might be merged with wastewater costs, with no way to extract the data. As a result, the final regressions were done on 53, rather than all 130, of the towns and villages in Cook County.

Probit Regression
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The data from the dataset were sorted in accordance with the probit regression on Franchise status. This resulted in three regressions, with the following explanatory variables:

1. Northern (Area), Northwestern (Area), Western (Area), Southwestern (Area), Population (per square mile), Household Income (Median), Household Size (Median), constant
2. Population (per square mile), Household Income (Median), Household Size (Median), constant
3. Population (per square mile), Household Income (Median), constant

We now give justification for each of the explanatory variables.

For the first probit regression, we chose to include only four of the five “area” variables. The reason for doing so was to avoid perfect collinearity. The southern area was arbitrarily excluded from the regression, with the understanding that the interpretation of the constant would then naturally include the relative effect of the southern area.

The second probit regression, which contained all the explanatory variables of the first regression excepting the area variables, was what could be considered the “base” regression, modelling that the effects on franchise status could be entirely captured by population density, median household income, and median household size. The economic theory behind this was that while demographic data of an area might affect franchise status, the difference across areas would be entirely captured by these three variables.
The third probit regression was identical to the second regression except for the exclusion of median household size. Similar to the second regression, the rationale for excluding median household size was that the relevant variables to franchise status (socioeconomic status of an area and persons per building) would be already captured by population density and median household income.

The results of these three regressions are given below, in Table 1.

Table 1. Probit Regression on Franchise

<table>
<thead>
<tr>
<th></th>
<th>Franchise</th>
<th>Franchise</th>
<th>Franchise</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Northern Area</td>
<td>-0.988</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.098)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northwestern Area</td>
<td>-0.521</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.814)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Western Area</td>
<td>-0.00004</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.931)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southwestern Area</td>
<td>0.086</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.005)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population per sq. mile</td>
<td>0.001***</td>
<td>0.0005***</td>
<td>0.0005***</td>
</tr>
<tr>
<td></td>
<td>(0.0002)</td>
<td>(0.0002)</td>
<td>(0.0002)</td>
</tr>
<tr>
<td>Median HHI</td>
<td>0.00001</td>
<td>0.00000</td>
<td>0.00000</td>
</tr>
<tr>
<td></td>
<td>(0.00001)</td>
<td>(0.00001)</td>
<td>(0.00001)</td>
</tr>
<tr>
<td>Median Household Size</td>
<td>0.224</td>
<td>0.321</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.172)</td>
<td>(0.999)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-2.064</td>
<td>-1.817</td>
<td>-1.001</td>
</tr>
<tr>
<td></td>
<td>(3.219)</td>
<td>(2.645)</td>
<td>(0.767)</td>
</tr>
<tr>
<td>Observations</td>
<td>53</td>
<td>53</td>
<td>53</td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-15.832</td>
<td>-16.348</td>
<td>-16.403</td>
</tr>
<tr>
<td>Akaike Inf. Crit.</td>
<td>47.663</td>
<td>40.696</td>
<td>38.805</td>
</tr>
</tbody>
</table>

Note: *p<0.1; **p<0.05; ***p<0.01
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As visible in the table, for all three regressions, it was found that the only explanatory variable that was statistically significant was Population Density. It should be noted that, when examined, Household Income (Mean) did not significantly change the results when examined in place of Household Income (Median). As a result, the latter option was chosen arbitrarily.

Linear Regression

The data was then used for two sets of linear regressions, one on Refuse Costs, and one on Refuse Costs per Capita. The first, on Refuse Costs, was two regressions with the following explanatory variables:

1. Northern (Area), Northwestern (Area), Western (Area), Southwestern (Area), Population, Population (per square mile), Household Income (Median), Household Income (Mean), Household Size (Median), Franchise status, constant

2. Population, Competitive status, constant

We now give justification for each of the explanatory variables.

For the first linear regression, as with the probit regression, we chose to include only four of the five “area” variables. The reason for doing so was, again, to avoid perfect collinearity. The southern area was arbitrarily excluded from the regression, with the
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understanding that the interpretation of the constant would then naturally include the relative effect of the southern area.

For interest of interaction with the Refuse Costs, we included both population and population density as explanatory variables, to examine whether one might be more descriptive. Furthermore, various household descriptors were included, in interest of whether it might capture some of the socioeconomic value of the refuse costs. Finally, Franchise Status was included to better determine what the resulting impact on costs may be.

The second probit regression ignored many of these explanatory variables from consideration, focusing entirely on population and competitive status (and a constant). With this, we hoped that by removing the massive impact of scaling population on costs, the value of a competitive system might be better uncovered.

The results of these two regressions are given below, in Table 2.

Table 2. Linear Regression on Refuse Costs
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<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Refuse Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>Northern Area</td>
<td>768,771.400</td>
</tr>
<tr>
<td></td>
<td>(656,904.900)</td>
</tr>
<tr>
<td>Northwestern Area</td>
<td>-85,747.020</td>
</tr>
<tr>
<td></td>
<td>(527,643.600)</td>
</tr>
<tr>
<td>Western Area</td>
<td>190,264.300</td>
</tr>
<tr>
<td></td>
<td>(542,046.900)</td>
</tr>
<tr>
<td>Southwestern Area</td>
<td>1,324,706.000**</td>
</tr>
<tr>
<td>Population</td>
<td>43.412***</td>
</tr>
<tr>
<td></td>
<td>(6.917)</td>
</tr>
<tr>
<td>Population per sq. mile</td>
<td>-48.932</td>
</tr>
<tr>
<td>Median HHI</td>
<td>0.075</td>
</tr>
<tr>
<td></td>
<td>(4.980)</td>
</tr>
<tr>
<td>Mean HHI</td>
<td>-83,923.990</td>
</tr>
<tr>
<td></td>
<td>(568,398.400)</td>
</tr>
<tr>
<td>Median Household Size</td>
<td>-554,344.700</td>
</tr>
<tr>
<td>Franchise</td>
<td>-99,970.950</td>
</tr>
<tr>
<td></td>
<td>(830,695.800)</td>
</tr>
<tr>
<td>Competition</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>886,295.000</td>
</tr>
<tr>
<td></td>
<td>(1,681,730.000)</td>
</tr>
<tr>
<td>Observations</td>
<td>53</td>
</tr>
<tr>
<td>R²</td>
<td>0.603</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.509</td>
</tr>
<tr>
<td>Residual Std. Error</td>
<td>1,053,782.000 (df = 42)</td>
</tr>
<tr>
<td>F Statistic</td>
<td>6.386*** (df = 10; 42)</td>
</tr>
</tbody>
</table>

*Note:*  
*p<0.1; **p<0.05; ***p<0.01*
As visible in the table, for both regressions, it was found that the only explanatory variable that was statistically significant was Population. The first regression also found that Southwestern Area was statistically significant, a point which will be discussed later.

The linear regressions were then conducted again, regressing three sets of explanatory variables on Refuse Costs per Capita. The three sets are as follows:

1. Northern (Area), Northwestern (Area), Western (Area), Southwestern (Area), Population, Population (per square mile), Household Income (Mean), constant
2. Population, Population (per square mile), Household Income (Mean), constant
3. Northern (Area), Northwestern (Area), Western (Area), Southwestern (Area), Population, Population (per square mile), Household Income (Mean), Household Size (Median), Franchise status, Competitive status, and a constant

We now give justification for each of the explanatory variables.

For every regression, we chose to regress Population, Population Density, and Household Income (Mean) on Refuse Costs per Capita. This is because the economic theory supported the idea that these demographic factors would have a substantial impact on refuse costs, separate from any of the other explanatory variables.

For the two of the linear regressions, as with the previous regressions, we chose to include only four of the five “area” variables. The reason for doing so was, again, to avoid perfect collinearity. The southern area (as before) was arbitrarily excluded from the
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regression, with the understanding that the interpretation of the constant would then naturally include the relative effect of the southern area. These factors were excluded for the second regression, to examine whether they would have any significant impact on the results.

Finally, a third regression was run that – while similar to the first regression – also included the Franchise and Competitive statuses, along with a descriptor for median household size. The theoretical support for this is that, in the third regression, we might capture the effects of the economies of contiguity. The reason both Franchises and Competition were included without causing collinearity is that some – not many, but a few – towns and villages actually disposed of refuse through public works, rather than outside companies.

The results of these two regressions are given below, in Table 3.

*Table 3. Linear Regression on Refuse Costs per Capita.*
It is notable that, for once, the effects of a town or village being in the southwestern area was statistically significant. The population density coefficient and the constant were statistically significant in the first and second regressions, but not the third. In the third regression, the Competitive status coefficient was statistically significant, but the population density coefficient and the constant were not.
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Results

First we discuss the results of the probit regression. As mentioned before, the population density coefficient was the only coefficient with statistical significance. The coefficient decreased substantially from .001 to .0005 when the area effect was removed. The significant of this could be explained that, when the differences in franchising likelihood due to area were considered separately, the density within a given area had almost twice as much relative significance.

From an economic standpoint, the sign of the coefficient makes sense – the greater the population density, the greater the potential savings from economies of contiguity, and so the greater likelihood that a town or village would have tried to benefit from these by engaging in a franchising contract.

These results carry over when we examine the results of the linear regression (per capita). As a momentary aside, we observe that in the regression on refuse costs (not per capita), no explanatory variable had a statistically significant coefficient except population. This makes direct sense – if refuse costs are not observed per-capita, there is little wonder that the sheer population of the town or village is the only significant determinant of costs.

Now, as we consider the refuse costs per capita, we note a few interesting conclusions that can be drawn for each of the three different regressions. We discuss these regressions in two sets: the first two regressions (without regressing on franchising/contracting) and the third regression (regressing on franchising/competition).

For the first two regressions, we note that population density coefficient and the constant were both statistically significant in determining the refuse costs per capita. This
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describes a fairly standard cost curve: the constant being a fixed cost (per capita) as well as a decreasing marginal cost (per capita) as population density increases. The signs of these values also agree with the economic theory – a positive value for the constant (a fixed cost) and a negative coefficient for population density (economies of contiguity).

For the third regression, the coefficient that was statistically significant was that for the competitive status. It seemed that competition significantly increased the cost per capita of refuse collection, relative to other options (public works, franchising contracts). It is notable that this coefficient did not grow significant when other demographic or geographic variables were considered or excluded – a fairly persistent effect. This is interesting, as one would normally think that competition would drive costs down – however, in this case it would make sense that the opposite is true, thanks to the economies of contiguity bringing most benefit in a franchised setting.

However, this regression also no longer had a significant coefficient for population density or a significant constant, which suggests that competition confounds some of the effects of the marginal cost curve. This is likely because while competition does not benefit from economies of contiguity, it does allow consumers to somewhat negotiate down the price of refuse collection. Therefore, it is only natural that it would be confounded by higher population density – there are more people, encouraging more competition between companies. With more companies competing (with their own cost curves) and more negotiation with customers, it makes sense that fixed and marginal costs would be even more obfuscated for the final regression,
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A final interesting point is that, when the area effect was considered, the only area with a statistically significant coefficient was that for the Southwestern area of Cook County. While all the areas had relatively similar standard deviations, the coefficient for the Southeastern area was substantially higher overall. This was true regardless of whether or not the franchising effect was considered. This would suggest that, for some reason, the Southwestern area of Cook County (including towns such as Orland Park, Palos Park, and Burbank), simply have significantly higher per-capita costs of refuse collection.
Conclusions

The most interesting points that we drew from the observation of franchising status and refuse costs for towns and villages across Cook County were fivefold.

1. Population density significantly increased the likelihood a town or village would participate in franchise contracts.
2. Determination of refuse costs (not per capita) are dominated by sheer population in a town or village – total cost is a function of quantity.
3. Refuse costs per capita typically decrease with population density, while having a relatively large fixed cost per person.
4. Competition seems to be costly in terms of refuse costs per capita across the board (relative to franchising or public works), but also seems to make fixed costs of refuse disposal and marginal benefits of population density less consistent across towns.
5. Refuse disposal in Southwestern Cook County is more expensive.

These conclusions seem to support the concept of economies of contiguity and the potential benefits of franchising, in particular findings (1), (3), and (4). Research for other regions of the state, or even the country, might better confirm whether these economies of contiguity are widespread.

Overall, it does seem to be the case that it is possible to determine whether a town or village might benefit from franchising. The answer to this question seems to be positive, with increasing confirmation as population density increases – the more densely populated a town
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or village, the more likely that it might benefit from switching from a competitive refuse disposal network to a contract with a specific corporate franchise.
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Works Cited


