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In Pursuit of Best Value: Comparing Air Force Contract Prices with those of Local Governments

November 2018

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Introduction

The Department of Defense (DoD) budgets approximately $25 billion every year on contracts for base operations support (BOS) services across 160 active-duty military installations in the United States. DoD bases procure standard BOS services such as grounds maintenance, custodial services, facilities maintenance, and waste disposal, just to name a few. With an ever-decreasing procurement budget, the DoD must ensure that each tax dollar obligated on contracts provides the best value to the government and its citizens. The DoD's greatest challenge in ensuring best value is the determination of fair and reasonable prices in all of its contracts for supplies and services. One approach for determining fair and reasonable prices is comparing prices paid with other DoD agencies as well as with other government agencies. Our research focuses on prices paid for a common BOS service: solid waste disposal. Specifically, we compare the prices paid per ton (i.e., average cost) on solid waste disposal services across (a) Air Force bases and (b) across Air Force bases and their neighboring cities. We focus on solid waste disposal because it is a uniform BOS category across bases, and prices paid can be readily compared to neighboring cities that also contract for waste disposal. Although we focus on Air Force bases because the data are readily available, our results have implications for other military bases and DoD agencies.

Background

While the nature of solid waste disposal services is essentially the same, there is significant variation in the prices paid (total and per unit) across Air Force bases. Moreover, it is unclear how the prices paid by military bases compare to those paid by the bases' neighboring cities. Indeed, the literature, to our knowledge, is silent on the base–city comparison. In principle, we would expect military bases to pay similar prices for standard services because they are non-profit government entities. Base prices, however, could exceed those of their neighboring cities if the DoD imposes a disproportionate regulatory burden on private vendors. In that case, we can view the city prices as a floor for comparison.

Recognizing that many agencies within the federal government purchase similar products and services, the Office of Management and Budget (OMB), in particular the Office of Federal Procurement Policy (OFPP), has promulgated category management and strategic sourcing implementation memorandums and guides (OMB, 2012; OMB, 2014; OMB, 2015). The main goals of category management are to achieve price, process, and demand savings by leveraging volume of spend (buying as one), reducing the number of contracts written (as well as the number of contracting offices writing contracts for similar products and services), and implementing internal controls to shape consumption. Strategic sourcing is one tool category managers can use to implement acquisition solutions within their categories.

Category management and strategic sourcing require extensive market research—a much more comprehensive examination and understanding of the markets for common products and services than the federal government has ever performed in the past. Category management teams compare historical government trends in spend, use, and consumption to historical commercial and near-peer trends. To better support such category management goals within the DoD, we study the prices paid for waste disposal services across Air Force (AF) bases, especially compared to prices paid for similar services by local cities.

Research Approach and Findings

In coordination with the Air Force Installation Contracting Agency (AFICA), we collect the total contract amount paid for solid waste disposal services, total tonnage of waste, and total number of containers for each AF base reporting these data. Since bigger bases house more people and generate more waste, we focus on the average cost per ton of waste disposal (i.e., the total contract amount paid for waste disposal divided by total tonnage of waste). We refer to the price paid per ton on waste disposal as the cost per ton because prices paid represent the costs of waste disposal for AF bases. Here, we find large differences in cost per ton across AF bases, ranging from $44 to $844. Additionally, the average cost per ton is negatively related to the number of waste containers on the base. Our interpretation is that firms incur high fixed costs of contracting with AF bases, namely more forms and training requirements. Such

regulatory costs are the same if the base has 50 containers or 750. This suggests there are economies of scale in waste disposal. Smaller AF bases could perhaps reduce their costs by coordinating with other government entities under a single waste disposal contract.

In the second part of our analysis, we compare AF bases to local cities. We first match each AF base to its nearest city. Then, we contact the city to learn the nature of its waste disposal contract and its costs of waste disposal. While 30 cities responded to our questions, we study only 20 cities where the waste disposal data are comparable to the AF base. Across these 20 cities, we find no significant difference in the price paid per ton across cities and AF bases. When we split the sample by the number of containers, though, we find that smaller bases with fewer than 75 containers pay almost twice as much per ton for waste disposal compared to their neighboring cities. We find no such base–city difference for bases with more than 75 containers. Smaller bases would therefore do well to contract with their neighboring cities for waste disposal.

Our findings benefit the Air Force and DoD by comparing the costs per ton of waste disposal across AF bases and between bases and their neighboring cities. Moreover, the methodology can be applied to study the variation in prices paid between DoD bases and local cities for other BOS-type services, such as custodial, grounds maintenance, and perhaps even professional services.

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Literature Review

The DoD has historically pursued collaborations between military installations and their surrounding cities. Many installations have established public-to-public partnerships (PuPs) used to procure and share services, expertise, and capabilities (Lachman, Resetar, & Camm, 2016). Military installations and local governments view these partnerships as a means for sustaining operations in an environment of declining budgets. These PuPs have been used to leverage "economies of scale benefits, provide cost avoidance, access partner capabilities and expertise, enhance the quality of services, and improve installation-community cooperation on issues of mutual concern" (Lachman et al., 2016, p. xiii).

Additionally, the 2013 National Defense Authorization Act (NDAA) provided statutory authority for military installations to enter into agreements with local and state governments for installation support services. These agreements, called intergovernmental support agreements (IGSAs), have been implemented at over 30 installations across the DoD. In a 2018 report, the Government Accountability Office (GAO) found that the DoD has realized financial and nonfinancial benefits from using IGSAs. These benefits include cost savings and cost avoidances as well as "enhanced mission effectiveness and readiness, reduced administrative time, and improved relationships with local communities" (GAO, 2018, p. ii). Specifically, the GAO reported the following:

> Moody Air Force Base realized an estimated $270,000 in savings in fiscal year 2017 by implementing an IGSA for water and wastewater treatment. In the IGSA's business case analysis, officials estimated that continuing to obtain this service from their existing contractor would have cost about $642,000, while the implemented IGSA cost was about $372,000, according to our analysis. (p. 10)

Furthermore, the GAO reported the following:

> Fort Polk realized an estimated $1.9 million in cost savings by implementing an IGSA for waste removal with its local government. Specifically, installation officials estimated that a private contract would have cost the installation about

> $4.5 million from June 2017 through May 2018, while we found that the implemented IGSA cost about $2.6 million for the same period. (pp. 9–10).

In developing IGSAs for installation support services, a first step includes comparing costs of services between military installations and local governments. This is the focus of our study. Our research compares the costs of integrated solid waste management (ISWM) services across Air Force bases and then between Air Force bases and their neighboring cities as an application of category management. Informing our research is a literature review encompassing three different areas: federal government and Air Force category management programs, Air Force base-level procurement research, and ISWM cost-reduction research.

Our research adds to the literature on federal government and Air Force category management programs. The federal government's category management programs are focused on reducing costs and increasing efficiency and effectiveness. The OMB (2014) initiative on "Buying as One Through Category Management" is focused on

> managing commonly purchased goods and services by implementing strategies to drive performance, like developing common standards in practices and contracts, driving greater transparency in acquisition performance, improving data analysis, and more frequently using private sector (as well as government) best practices. (p. 2)

The Air Force's category management program evolved from the DoD's commodity sourcing strategies, which focused on total ownership costs and strategic sourcing strategies (Rendon, 2005). Category management is focused on "leveraging buying power, improving efficiencies, and managing consumption" (Sharkey, 2015, p. 7). The Air Force conducts category management by analyzing major performance levers (demand management, supplier management, strategic sourcing, and total cost management) to identify category improvement initiatives. Within the total cost management lever, the focus is on identification of specific price drivers in the acquisition that can result in increased efficiency and effectiveness and a reduction in costs. Price drivers can be either product/service-related or contract-related and impact savings associated with rate (getting more for less), process (getting more with less),

and demand (getting less; Sharkey, 2015, pp. 21–24). The product/service-related price drivers impact rate savings, process savings, and demand savings. Contracting-related price drivers impact rate savings. Once these price drivers are identified, the Air Force executes changes to its acquisition strategies for these supplies/services and then conducts performance tracking, benchmarking, and continuous improvement of the management of the specific category of products/services (Sharkey, 2015, pp. 25–33).

Our research also adds to the ISWM literature, specifically analyzing approaches to reducing costs for solid waste management. The recent stream of ISWM research has been centered mainly on exploring the most cost-effective waste collection systems. For example, Boskovic, Jovicic, Jovanovic, and Simovic (2016) developed a management tool to determine waste collection costs for different waste collection schemes and input data. The tool can calculate the time and costs of waste collection. Also, Arribas, Blazquez, and Lamas (2010) proposed a methodology for designing an urban solid waste collection system that uses combinatorial optimization and integer programming, and geographic information system tools to minimize collection time, and operational and transport costs. Their methodology establishes feasible collection routes, determines an adequate vehicle fleet size, and presents a comparative cost and sensitivity analysis of the results. Their research findings yielded significant cost savings in the total solid waste collection system. Finally, Solano, Ranjithan, Barlaz, and Brill (2002) developed an ISWM model to assist in identifying alternative ISWM strategies that meet cost, energy, and environmental emissions objectives. The model is flexible to allow representation of waste diversion targets, mass flow restrictions and requirements, and targets for the values of cost, energy, and emission.

Specific to Air Force ISWM services, Landale, Apte, Rendon, and Salmeron (2018) show how data analytics can be used to identify areas of potential cost savings for ISWM services. Using sequential regression, Wilcoxon Rank-Sum Test, and ordered logistic regression, they investigated the influence of service- and contracting-related variables on price and contractor performance. They found that service-related and contracting-related variables influence price. Specifically, they identified that a service-related variable, the number of containers, significantly affects price; and that two contracting-related variables, one type of small business set-aside and the number of offers received, also significantly affect price.

With the growth in procurement of base-level services, there is a developing stream of research focused on improving contracting for base-level services. For example, Apte, Rendon, and Salmerón (2011) developed an optimization model for selecting a set of contractor proposals from among multiple offerors for base-level services to be performed at multiple installations. The selection balanced the confidence level in an offeror's past performance with the cost of services to the USAF, thereby achieving the most favorable objective. Their research findings demonstrate improvements over the traditional sourcing process in both overall performance and cost. Additionally, Boehmke, Jackson, Johnson, White, Weir, and Gallagher (2017) use a data envelopment analysis (DEA) approach to measure efficiency in installation support services. By focusing specifically on facility sustainment activities, their DEA approach supports decision-making by "quantifying cost savings and performance improvements, and systematically bench-marking to identify best practice peers" (Boehmke et al., 2017, p. 39). Also, Boehmke, Johnson, White, Weir, and Gallagher (2015) apply a growth curve clustering approach to identify cost curve behavior in their research on analyzing cost growth and investigating approaches to reducing cost growth in the Air Force. Their findings indicate that micro-level growth curves vary greatly from the aggregate cost curves. They also found that their clustering approach can help decision-makers direct their focus and policies toward specific growth curves that must be "bent" (Boehmke et al., 2015, p. 126).

Finally, our research includes an analysis of municipal government costs for contracting ISWM services. Although contracting at the municipal and city level is a vast and decentralized effort, it is one of the most "under-studied" aspects of government contracting (Haselmayer, 2018, p. 1). With "557,000 city and municipal governments procuring an estimated 10% of the world GDP in goods and services annually to serve their communities," this area of government contracting is a fertile ground for the application of category management processes (Haselmayer, 2018, p. 1). Our paper adds to the various research streams related to category management, ISWM cost reduction, and base-level services. We focus on comparing ISWM costs at Air Force bases to those at the bases' surrounding municipalities.. In the next chapter, we discuss our research data and methodology.

Data and Methodology

Our analysis has two parts. First, we collect data on AF prices paid for waste disposal. Second, we compare and contrast the prices of waste disposal between AF bases and their neighboring cities. To this end, we contacted local cities near each base and collected information on their waste disposal contracts and costs. We begin by describing the data on the AF bases.

Air Force Base Data

We collected data on waste disposal costs for 68 AF bases in the continental United States as of 2017. Our student researchers contacted the Air Force Installation Contracting Agency (AFICA) to collect price data on ISWM service, which includes the costs of waste disposal and other categories under ISWM. This data set, organized by base, was jointly compiled by AFICA and the Air Force Civil Engineer Center (AFCEC), the mission owner for facilities-related services. The data set contains (a) the annual contract price for solid waste services, which was pulled from the Federal Procurement Data System-Next Generation (FPDS-NG) by AFICA, and (b) the number of bins and tons of solid waste, which was collected by AFCEC. Unfortunately, these data were missing for many bases. Our analysis sample therefore focuses on 48 bases with complete data.

AFICA reports total contract costs for solid waste disposal that are annualized based on the past three to five years of contract data. Comparing total prices paid for solid waste disposal across AF bases is not informative because larger bases are likely to generate more waste and hence pay more for solid waste disposal, but AFCEC reports the annual total tonnage of waste disposal. So, we constructed a more informative measure, namely the annual price/cost per ton (total annual contract cost of waste disposal divided by tons of waste disposal). We find significant variation in the cost per ton, from a high of $855 per ton at Columbus AF base in Mississippi to $41 per ton at Dyess AF base in Texas. The mean is $270 with a standard deviation of $159 across 48 bases.

To understand the variation in waste disposal costs across bases, we also collected data on the number of waste disposal containers. We may expect a non-linear relationship between the number of container and solid waste costs per ton on account of economies of scale. Average costs per ton are likely to decrease as the number of containers increases because of higher fixed costs compared to variable costs of waste disposal. We discuss economies of scale in the next section.

Local Municipality Data

After collecting the necessary AF data, we selected local cities near each base based on two rules: the city/municipality should lie within 30 miles of the AF base and must be part of the same county. This ensures we are comparing an AF base to a city that faces similar market conditions. Moreover, the closeness of the city and base suggests they could in principle use the same commercial vendor for waste disposal. Our goal in collecting these data are to compare and contrast the waste disposal costs of AF bases to their neighboring cities. Since both entities are public, we expect the costs to be similar across bases and their neighboring cities. Similar to bases, cities are non-profit government organizations, albeit with fewer regulatory hurdles than bases.

Before our students contacted the cities, they spoke to the City of Monterey to understand its process of solid waste contracting. The idea was a conversation with local city officials would lead us to design more effective questions for the larger data collection effort. In particular, our students met with the sustainability coordinator for the city. They learned that cities contract for waste disposal in four different ways, namely (a) franchise agreements, (b) city-owned solid waste haulers, (c) three- to five-year term contracts with commercial vendors, and (d) open market contract with operating permits. Interestingly, AF bases rely only on (c).

Based on this visit, we asked the matched cities the following five questions. The appendix shows the standard email solicitation we sent to each city.

1. What type of contract does your city use for solid waste disposal?
2. What are the negotiated rates for solid waste collection at city-owned buildings (per bin size and frequency of collection)?

3. What are your published prices for commercial business rates for solid waste collection (per bin size and frequency of collection)?
4. Is the local Air Force base's solid waste contract managed by your city? What are the Air Force base's rates? Are the Air Force base's rates the same as the negotiated rates for the city? What is the surcharge rate applied to the Air Force for the city to manage its solid waste contract?
5. Are there standing city regulations requiring the local Air Force base to utilize the same hauler that is already contracted with the city?

Answers to these questions provide information on the contracts used and the prices paid for waste disposal by neighboring cities. Our student researchers used the following protocol in collecting data from these cities. First, they contacted each city's government office by phone and identified the solid waste contract administrator. They introduced themselves as military officers studying at the Naval Postgraduate School and briefly explained the study using a script. After the initial phone introduction, they followed up with a standard e-mail. We were concerned some cities would be reluctant to share their contract information. Hence, we added the following language: "the information you provide will be treated as confidential. Our report will be sanitized of any city, Air Force base, or commercial hauler names. After the report is complete, we would be happy to share our findings with you."

Our student researchers contacted 69 cities matched to adjacent AF bases. Each city was contacted multiple times by phone and e-mail over three months. By the end of the three months, 31 of the 69 cities responded, translating into a 45% response rate. Barring one region, the distribution of responses was uniform in other parts of the country. For example, 60% of cities responded in the south and southwest regions (19/32 bases), and 64% of midwestern cities responded (9/14). Our lowest response rate was in the northeast. Indeed, not one city adjacent to any of the nine AF bases in the northeast responded. Figure 1 displays the cities that responded to our questions. We review findings from these cities in the next chapter.

Figure 1. Responding Cities Adjacent to AF Bases

Unlike AF bases that report their annual cost of waste disposal and tons of solid waste, cities without exception report a cost per cubic yard of solid waste along with the frequency of collection (number of times per week) and the size of the waste container (2 cubic yards, 4 cubic yards, and so forth). To ensure an apples-to-apples comparison, we estimated an equivalent cost per ton for each city in the following manner.

City unit costs were measured as costs per cubic yards, where cubic yards came in many sizes ranging from 2, 4, 6, and 8 cubic yards. Moreover, the cost of each container size varied by the frequency of scheduled solid waste collection, ranging from one to five times per week. For example, a city in the southwest reported its cost per cubic yard increases from $57 for a collection of once per week to $312 for six times per week. As the cubic yards increased, the cost also increased, though again in a non-linear manner.

Our first challenge was converting the city costs per cubic yard, a measure of volume, to AF costs per ton, a measure of weight. We used the Environmental

Protection Agency's Office of Resource Conservation and Recovery standard volume-to-weight conversion factors to convert cubic yards to tons of solid waste (EPA 2016, p. 5). These published conversion factors suggest the standard weight per cubic yard of un-compacted, residential, institutional, and commercial solid waste translates into an estimated weight of 250 to 300 pounds, namely 0.125 to 0.15 tons. We created estimates of costs per ton for each matched city using the 300-pound (0.15 tons) estimate of the weight range. Our patterns are similar if we use the lower 250-pound estimate.

We also made a decision to use the city costs for once-a-week collection. We selected once a week to err on the side of constructing a higher estimate for city waste prices. Cities paid more per unit for once-a-week collection compared to five times a week. Since most of our cities report their data for a two-cubic-yard container emptied once a week, our choice of once-a-week collection also ensured a larger matched city sample. We unfortunately had to exclude cities that did not provide data for two-cubic-yard containers collected once a week and those reporting other units of measure. This left us with 20 cities matched to their nearest AF bases. On account of the small sample, we report *t*-tests for the difference in means of costs per ton between AF bases and their neighboring cities. We turn to these results next.

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Findings

We begin by showing the variation in average cost per ton across AF bases. In Figure 2, we plot the average cost per ton on the *y*-axis against the number of waste containers on the *x*-axis. Indeed, this picture suggests economies of scale can perhaps account for some variation in average costs across AF bases. Columbus AF base has the highest cost per ton at $855 and fewer than 100 containers. In comparison, Robins AF base in Georgia with 586 containers has an average cost per ton of $110. Economies of scale arise when there are huge fixed costs compared to marginal costs of waste disposal. It is likely that waste disposal companies face higher fixed costs of contracting with the DoD and getting on an AF base. Conditional on those costs, it seems the cost of hauling each additional container is low. We use the term *average cost per ton* interchangeably with *annual price per ton*, namely the annual price per ton paid by an AF base for waste disposal.

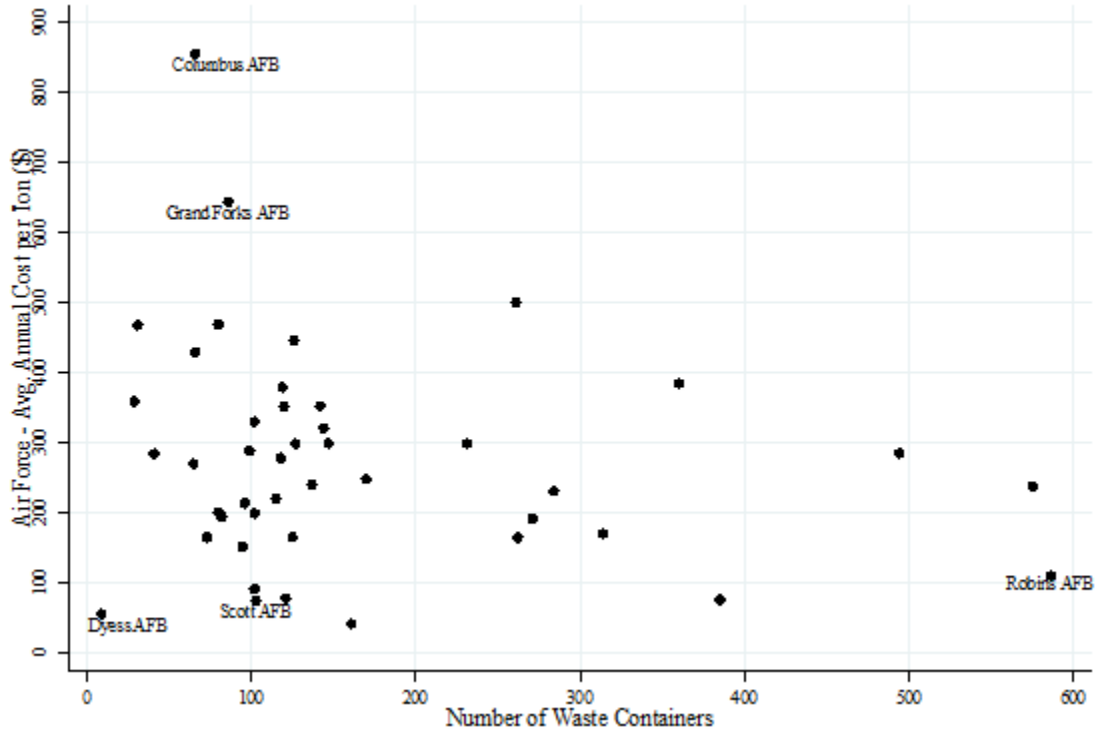

Figure 2. Waste Disposal Average Annual Cost and Number of Containers Among AF Bases

The presence of economies of scale suggests smaller AF bases could in principle reduce their costs if they joined forces with neighboring cities. This would allow them to leverage their containers with cities and secure a lower price per ton from waste disposal companies. Indeed, smaller bases would have more bargaining power negotiating with commercial waste disposal companies as they would be negotiating over a larger amount of waste disposal (small base plus neighboring city as one entity).

Nonetheless, economies of scale are not the entire story because we observe large differences in costs per ton for bases with the same number of containers. Indeed, there are striking differences in costs for bases with around 100 containers. For example, average costs range from a low of $75 at Scott AF base in Illinois to a high of $644 at Grand Forks AF base in North Dakota. To understand this variation, we turn to the matched city comparison next.

We study 20 matched AF–city comparisons between AF bases and their neighboring cities. Of the 31 cities that responded to our request, three were unable or unwilling to provide cost/price data due to proprietary relationships with their ISWM contractors. Another five cities did not provide detailed cost data, and we were unable to normalize their data to costs per ton. The remaining three cities gave us sufficient cost data, but AFICA and AFCEC did not have sufficient cost data for their neighboring AF bases.

Figure 3 shows the comparison of AF and matched city price per ton for each AF base. In this sample of 20 matched pairs, the cities' average cost per ton is $203 compared to $236 for AF bases. This difference, though, is not statistically significant at conventional levels of significance (95% or 90% level of confidence). AF bases have a higher coefficient of variation, 81%, suggesting their values are more dispersed compared to cities at 67%.

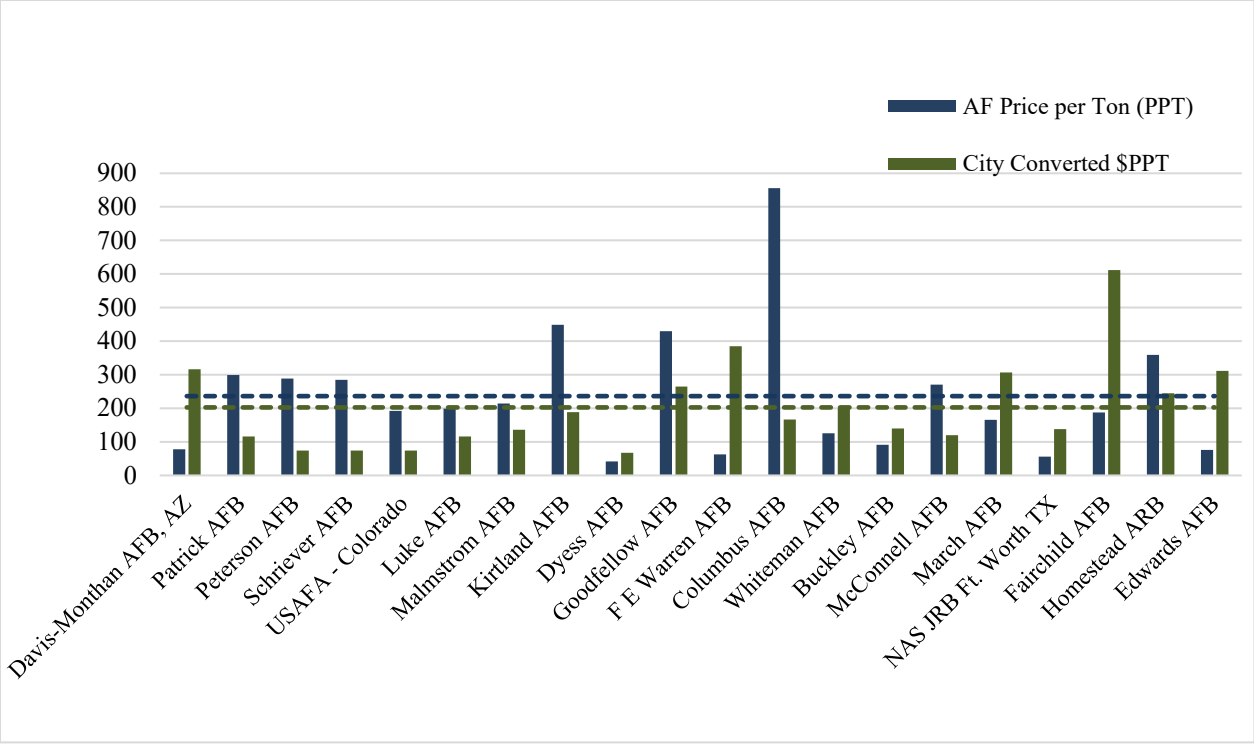

Figure 3. AF Base and City Waste Disposal Cost per Ton ($)

Of the 20 matched cases, the AF cost per ton is higher for 11 cities, and in the case of seven of these 11, the AF cost per ton is almost twice as high as the matched city. To assess if there are any systematic patterns in these 20 matched cases, we split the sample by number of containers into big and small AF bases. Bases with fewer than 75 containers were binned as small, while the rest were binned as large. Across the seven small bases, the AF cost per ton averaged $346 compared to $188 in the neighboring city. This is a striking difference as seen in Figure 4.

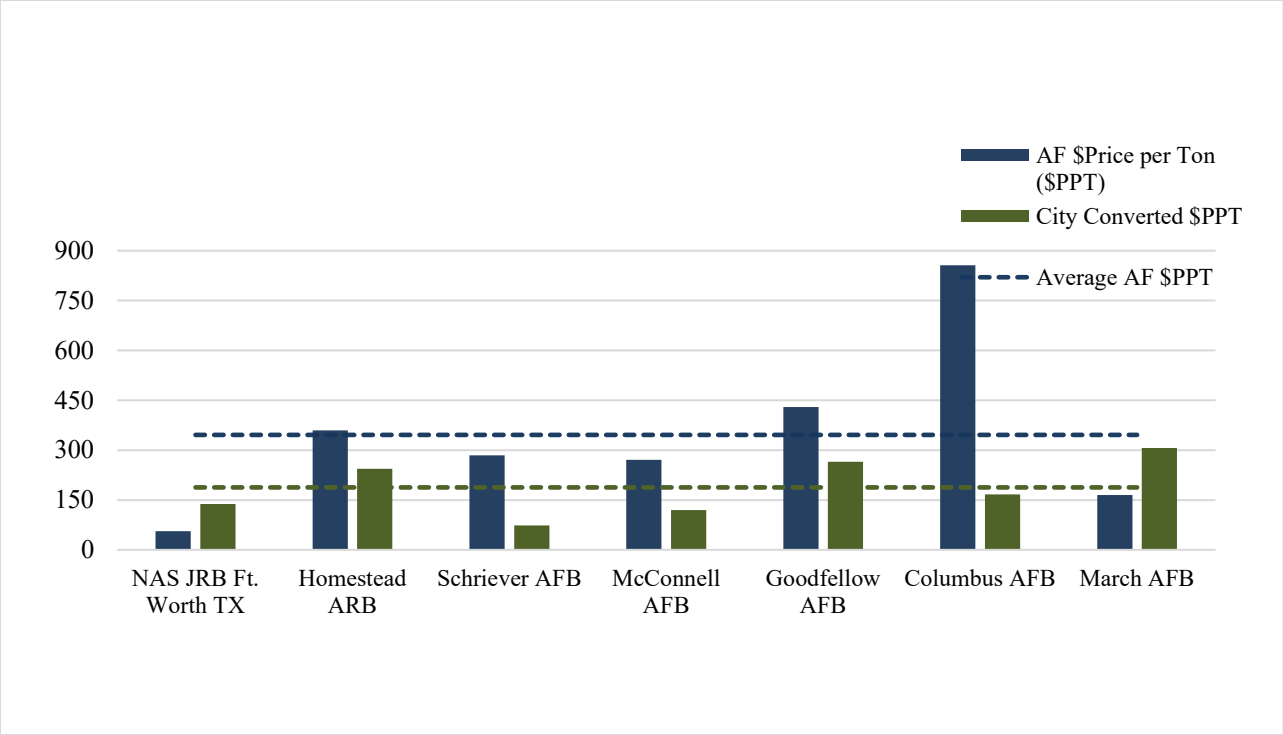

Figure 4. Waste Disposal Cost per Ton on Bases With Fewer Than 75 Containers

Small bases are at a significant disadvantage, most likely on account of their size and the economies of scale associated with waste disposal. Our recommendation is that these bases would be better served if they coordinated with their neighboring cities for waste disposal. In contrast, the cost per ton averages $164 for bigger bases compared to $150 for their neighboring cities as seen in Figure 5. The difference is small and statistically insignificant. Both the matched AF base–city and AF base only analysis thus suggest economies of scale maybe an important factor in contracting for waste disposal.

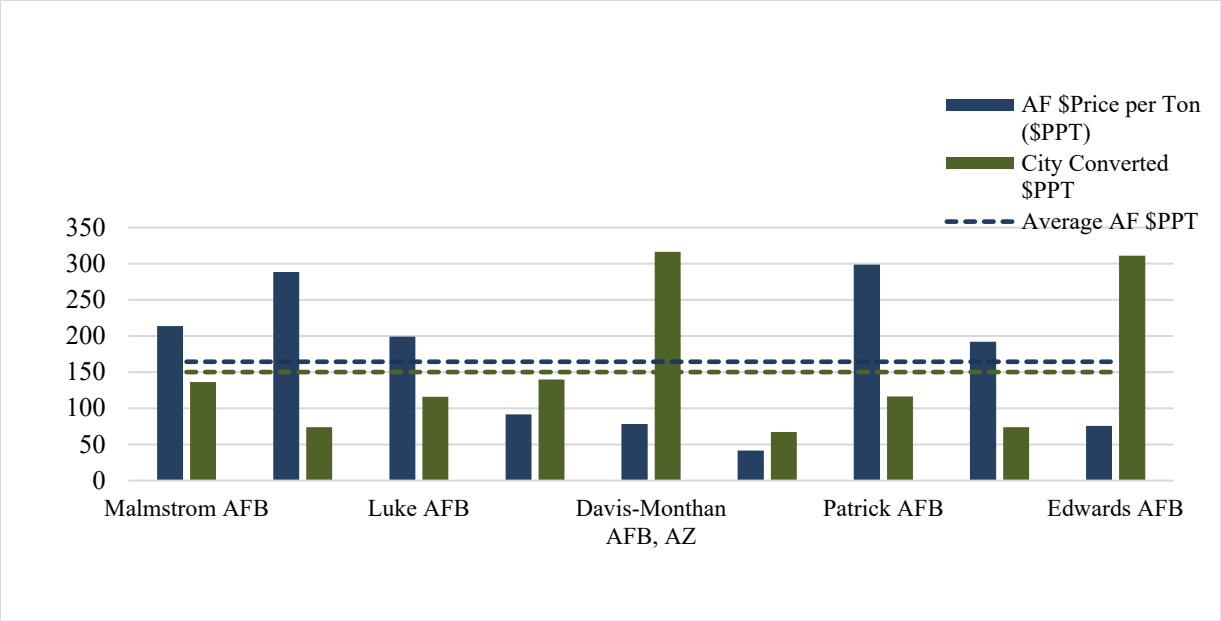

Figure 5. Waste Disposal Cost per Ton on Bases With 75+ Containers

Before concluding, we want to review qualitative findings from the matched AF base–city analysis for the 31 cities that responded to our questions. In our sample, cities managed their waste disposal services in five different ways. Of the 31 cities, 10% (three cities) used a three-year term contract and 16% (five cities) used a five-year term contract. Such contracts are perhaps most similar to standard AF contracts, but 39% (12) of cities managed ISWM services in-house. This could perhaps be an option for larger AF bases that can exploit their economies of scale by moving services in-house. Another 22% (seven) use a franchise agreement, and, finally, 13% (four) use an open market via an annual city-issued permit. In the latter cases, cities revoke a vendor's permit if they receive too many complaints against a vendor and the cities can validate those complaints.

In response to our question of whether the city managed the local AF base's solid waste contract, only one city answered in the affirmative. We were surprised that AF bases chose not to contract with their neighboring cities even when cities managed their own solid waste program. At least for smaller bases, this would seem like a more cost-effective option. Unlike cities, AF bases have more uniform contracting arrangements that perhaps do not exploit local conditions leading to franchise contracts

by some cities and in-house provision by others. At the very least, we believe AF contracting officers would be better served if they had basic information on the type of contract and cost per ton paid by their local city, a non-profit government organization, for waste disposal. We suggest contracting officers contact their local governments to investigate partnering for ISWM services as part of their required market research.

Conclusion and Recommendations

We find no significant difference in costs per ton for waste disposal between AF bases and their neighboring cities. When we split the sample by size, though, we find smaller bases have significantly higher costs (i.e., pay higher prices) for waste disposal; AF costs per ton are almost twice as high for smaller bases (fewer than 75 containers) compared to larger bases. Our first recommendation is that smaller AF bases should review their waste disposal contracts, compare and contrast their costs relative to their neighboring cities, and then consider coordinating with their neighboring cities to reduce their costs of waste disposal.

Our second recommendation is that the Air Force standardize the contract line item number (CLIN) cost data in ISWM contracts across all AF bases. As we collected the cost breakdown from AFICA, we quickly learned that each base formats its CLINs differently. More importantly, none of the bases report the data per industry standards. We had to normalize the data to prices paid per ton/cost per ton to make informed comparisons across bases. Unlike AF bases, U.S. cities record their waste disposal costs in terms of prices paid by bin size, number of bins, and frequency of pick-up. This seems to be the industry standard. We had to make assumptions on conversion from cubic yards (volume measure) to tons (weight). In an ideal world, AFCEC would be collecting the data by industry standards.

Finally, we had to find appropriate conversion factors to compare the data to local cities. It is hard to imagine AF contracting officers undertaking such research before they award contracts. We believe Air Force officers need comparable information on prices paid by neighboring non-profit and even for-profit entities to make informed decisions on what is a fair and reasonable price. We hope the Air Force makes such information available to its contracting officers.

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References

Achillas, C., Moussiopoulos, N., Karagiannidis, A., Banias, G., & Perkoulidis, G. (2013). The use of multi-criteria decision analysis to tackle waste management problems: A literature review. *Waste Management & Research, 31*(2), 115–129.

Apte, A., Rendon, R. G., & Salmerón, J. (2011). An optimization approach to strategic sourcing: A case study of the United States Air Force. *Journal of Purchasing & Supply Management, 17*(4), 222–230.

Arribas, C. A., Blazquez, C. A., & Lamas, A. (2010). Urban solid waste collection system using mathematical modelling and tools of geographic information systems. *Waste Management & Research, 28*(4), 355–363.

Boehmke, B. C., Jackson, R. A., Johnson, A. L., White, E. D., Weir, J. D. & Gallagher, M. A. (2017). Measuring U.S. Air Force installation support activities via data envelopment analysis. *Military Operations Research*, *22*(1), 39–58.

Boehmke, B. C., Johnson, A. L., White, E. D., Weir, J. D., & Gallagher, M. A. (2015). Bending the cost curve: Moving the focus from macro-level to micro-level cost trends with cluster analysis. *Journal of Cost Analysis and Parametrics*, *8*(2), 126–148.

Boskovic, G., Jovicic, N., Jovanovic, S., & Simovic, V. (2016). Calculating the costs of waste collection: A methodological proposal. *Waste Management & Research, 34*(8), 775–783.

Environmental Protection Agency (EPA). (2016, April). *Volume-to-Weight Conversion Factors*. Office of Resource Conservation and Recovery. Washington, DC: Author. https://www.epa.gov/sites/production/files/2016-04/documents/volume_to_weight_conversion_factors_memorandum_04192016_508fnl.pdf

Government Accountability Office (GAO). (2016, October). *Federal procurement: Smarter buying initiatives can achieve additional savings, but improved oversight and accountability needed* (GAO-17-164). Washington, DC: Author.

Government Accountability Office (GAO). (2018, October). *DoD installation services: Use of intergovernmental support agreements has had benefits, but additional information would inform expansion* (GAO-19-4). Washington, DC: Author.

Haselmayer, S. (2018). The de-globalized city. *New Global Studies*. doi:10.1515/ngs-2018-0013

Henderson, B. D. (1975). The coming revolution in purchasing. *Journal of Purchasing and Materials Management, 11*(2), 44–46.

Kraljic, P. (1983). Purchasing must become supply management. *Harvard Business Review, 61*(5), 109–117.

Lachman, B. E., Resetar, S. A., & Camm, F. (2016). *Military installation public-to-public partnerships: Lessons from past and current experiences* (No. RR-1419-A/AF/NAVY/OSD). Santa Monica, CA: RAND.

Landale, K. F., Apte, A., Rendon, R. G., & Salmeron, J. (2018). Using analytics to inform category management & strategic sourcing. *The Journal of Defense Analytics and Logistics* Vol 1, (2), 151-171.

Monczka, R. M., Handfield, R. B., Giunipero, L. C., & Patterson, J. L. (2015). *Purchasing and supply chain management.* Independence, KY: Cengage Learning.

Office of Management and Budget (OMB). (2012, December 5). *Improving acquisition through strategic sourcing* [Memorandum]. Retrieved from https://www.nrc.gov/docs/ML1234/ML12345A356.pdf

Office of Management and Budget (OMB). (2014, December 4). Transforming the marketplace: Simplifying federal procurement to improve performance, drive innovation, and increase savings. Retrieved from https://www.whitehouse.gov/blog/2014/12/04/transforming-marketplace-simplifying-federal-procurement-improve-performance-drive-i

Office of Management and Budget (OMB). (2015). *Government-wide category management document—Version 1.0*. Retrieved from thecgp.org/images/Gov-wide_CM_Guidance_V1-2.pdf

Rendon, R. G. (2005). Commodity sourcing strategies: Processes, best practices, and defense initiatives. *Journal of Contract Management, 3*(1), 7–20.

Rendon, R. G., & Templin, C. R. (1992, July). Corporate procurement strategy: An analysis of supply line management. *Contract Management, 32*(7), 18–25.

Sharkey, J. (2015, November 4). Buying as one through category management. Wright-Patterson Air Force Base, OH: Air Force Base Contracting Agency, Enterprise Sourcing Directorate (SJP1).

Solano, E., Ranjithan, S. R., Barlaz, M. A., & Brill, E. D. (2002). Life-cycle-based solid waste management. I: Model development. *Journal of Environmental Engineering, 128*(10), 981–992.

Tabachnick, B. G., & Fidell, L. S. (2007). *Experimental designs using ANOVA*. Belmont, CA: Thomson/Brooks/Cole.

Appendix: E-Mail Sent to City Governments

Dear XXXX,

My name is Lieutenant Commander XXXX. I am a student at the Naval Postgraduate School conducting research on solid waste contract costs. Our research team is comparing and contrasting the costs of solid waste disposal between Air Force bases and their neighboring cities. We hope this will help military leadership in deciding the types of service contracts it should pursue across bases.

To that end, my team and I are inquiring as to how municipalities manage their solid waste contracts in an effort to use them as a model to improve Air Force contract processes. I am hoping that you can answer a few quick questions in support of our research for the military and the federal government.

- What type of contract does your city use for solid waste disposal?

- What are the negotiated rates for solid waste collection at city-owned buildings (per bin size and frequency of collection)?

- What are your published prices for commercial business rates for solid waste collection (per bin size and frequency of collection)?

- Is the local Air Force installation's solid waste contract managed by your city? What are the Air Force base's rates? Are the Air Force base's rates the same as the negotiated rates for the city? What is the surcharge rate applied to the Air Force for the city to manage its solid waste contract?

- Are there standing city regulations requiring the local Air Force installation to utilize the same hauler that is already contracted with the city?

The information you provide will be treated as confidential. Our report will be sanitized of any city, Air Force installation, or commercial hauler names. After the report is complete, we would be happy to share our findings with you.

Thank you very much for your time and support; your vital contribution to our research will help improve Department of Defense contract processes.

Sincerely,

XXXX

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