Contrasting Different Geographies in Fair Market Rents: Implications for the Housing Choice Voucher Program in Pittsburgh, PA

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Abstract

Local public housing authorities define the payment standards—the voucher amounts paid to landlords—for renting their property under the Housing Choice Voucher (HCV) Program. Payment standards have been historically based on 40th percentile Fair Market Rents (FMRs) calculated by the U.S. Department of Housing and Urban Development (HUD) for metropolitan areas and non-metro counties. To better align payment standards with market rents, HUD has developed 40th percentile Small Area Fair Market Rents (SAFMRs) at the ZIP-Code level and have mandated their use in 24 metropolitan areas. Public housing authorities using SAFMRs in lieu of FMRs must maintain payment standards within 10 percent of the SAFMR. This study compares the efficacy of SAFMRs with rents listed for Pittsburgh, PA, by Rent Jungle, a commercial aggregator of rental data. Correlations between SAFMRs and the sampled rents were relatively low at 37 percent. Results indicate that small area markets defined using a combination of clustering and nearest neighbor algorithms are better predictors of market rents than ZIP Codes and require fewer market delineations, as shown by the adjusted R-squared exceeding 60 percent with only three clusters (compared with the 26 ZIP Codes in Pittsburgh). Results suggest that SAFMR achieves its goal of increasing the eligible units relative to FMR. Those increases were disproportionately in low-rent areas, however, where the proposed SAFMR is competitive with market rents. In contrast, in high-rent areas, the SAFMR is more than 50 percent lower than market rents, on average, resulting in few eligible units. These observations suggest SAFMRs are likely to increase the number of landlords interested in the HCV program in low-rent areas, but not in high-rent areas. To increase the use of vouchers in high-rent areas, payments to landlords should adequately compete with market rents. Otherwise, only landlords in high-rent areas that have trouble renting in the private market, such as those that offer properties of marginal quality, are likely to participate in the HCV program.

Introduction

The U.S. Department of Housing and Urban Development (HUD) funds the Section 8 Housing Choice Voucher (HCV) program. Section 8 uses a public-private partnership model that allows qualified tenants to rent on the open market from willing landlords of private properties that meet federal housing quality standards. HUD disperses funds to public housing authorities (PHAs) who are responsible for administering Section 8 at the local level.

Landlords are compensated through a combination of public assistance (vouchers issued by housing authorities or the payment standard) and rent paid by tenants. HUD defines a market rent basis that, in turn, limits the range of voucher amounts—or payment standards—allowable by PHAs. Historically, HUD has defined the fair market rent (FMR) as the 40th percentile of gross rents by FMR area. The FMR area consists of either the parent metropolitan statistical area (MSA) surrounding a PHA or subset of geographies within the parent MSA customized by HUD for HCV called the "HUD Metro Fair Market Area" or "HMFA." Local PHAs are allowed to set payment standards to vary from 90 percent to 110 percent of the FMR. Pinning payment standards to 90 percent to 110 percent of the FMR kept payment standards relatively affordable but has also concentrated HCV tenants in lower market rent areas (per the 40th percentile FMR criteria), which is often in areas associated with fewer economic opportunities.

Recognizing that rental market boundaries are difficult for housing authorities to define, HUD proposed ZIP Codes serve as small area market boundaries and designed a method for estimating market rents by ZIP Code (HUD, 2019a), or Small Area Fair Market Rents (SAFMRs). In November 2016, HUD mandated the use of SAFMRs as opposed to FMRs in deriving payment standards for PHAs in 24 metropolitan areas. Notably, the minimum and maximum SAFMR is restricted to 50 percent and 150 percent of the FMR, respectively.

ZIP Codes were partly selected for convenience in that they are familiar to renters, landlords, and housing authorities. ZIP Codes are also sufficiently large such that rents can be estimated using the American Community Survey (ACS; Reina, Acolin, and Bostic, 2019). HUD also relied on early results from demonstrations of SAFMRs in Cook County, IL; Long Beach, CA; Chattanooga, TN; Mamaroneck, NY; Laredo, TX; and Dallas, TX, to suggest that ZIP Codes would increase access to opportunity in markets nationwide (Finkel, 2017; Reina, Acolin, and Bostic, 2019).

HUD's method for estimating 40th percentile SAFMRs by ZIP Code uses a series of reliability and consistency standards applied to rents collected by the U.S. Census Bureau through the ACS (HUD, 2019a). By defining market rents at geographies smaller than MSAs and counties, HCV tenants are more likely to find units in higher rental areas with more economic opportunities because PHAs can set payment standards better aligned with local market rents. The smaller geography associated with the SAFMR is anticipated to accommodate the twin goals of expanding access to higher income markets for HCV tenants and thus reducing the concentration of HCV tenants in higher poverty areas.

A primary concern regarding SAFMRs is determining how representative ZIP Codes are of true rental market boundaries. Ideally, market areas would be intuitive to PHAs, voucher holders, and landlords, and align ZIP Codes, which could create incentives for landlords to participate in the

HCV program and for households to move to areas of opportunity. Otherwise, payment standards would be misaligned with market rents.

Researchers and affordable housing stakeholders have expressed concern about the appropriateness of ZIP Codes for defining small area markets (CFR, 2016; Treat, 2018; Walter, 2018). ZIP Codes are geographic boundaries established to administer postal delivery. Thus, prima facie concerns are that ZIP Codes will not align with rental markets, where market variation within ZIP Codes could be significant, and ZIP Code boundaries could cross municipal boundaries.

In theory, additional concerns associated with transitioning to SAFMRs are (1) landlords participating in the HCV program under FMRs will exit the program because payment standards in many of these areas should decrease by definition (HCV properties whose rents are below the 40th percentile of gross FMR are likely in ZIP Codes with even lower market rents); (2) it will be harder to attract landlords in areas of opportunity given market competition and a history of discrimination toward voucher holders; (3) the total voucher budget may not support increased vouchers associated with significant moves to areas of opportunity; and (4) the transition may facilitate a net decline in total HCV units.

The limited research exploring these issues is mixed. SAFMR demonstration projects in five PHAs indicate households moving to higher rent areas increased from 18 percent in 2010 to 28 percent in 2015, where most of the cost increase was borne by tenants. The net housing units eligible for subsidies across the SAFMR demonstration regions declined by 3.4 percent, however, due to reductions in the eligible units in lower rent areas (Finkel et. al., 2017). Significant variation across regions was observed. These results suggest that moves to higher rent areas, with improved neighborhood conditions, may not have been motivated by tenants' interest in areas of opportunity but more simply by geographic shifts in eligible units. In contrast to the decline in overall units estimated by SAFMR demonstration efforts, the NYU Furman Center (NYU, 2018) estimated that the number of HCV-eligible units in the 24 areas mandated to adopt the new SAFMRs is expected to increase by 9 percent.

Reina, Acolin, and Bostic (2019) used a difference-in-differences method to examine the geographic distribution of subsidized households before and after the SAFMR demonstration, finding increased voucher holders in higher rent neighborhoods in Dallas, TX; Long Beach, CA; and Mamaroneck, NY. Collinson and Ganong (2014) similarly reported that voucher recipients in Dallas moved to neighborhoods improved with respect to crime, poverty, unemployment, educational attainment, and fourth-grade test scores in public schools. Reina, Acolin, and Bostic found marginal to negative impacts of SAFMR in Cook County, IL, and Chattanooga, TN, however. The authors reported a potential decline in neighborhood quality for voucher holders in Chattanooga following SAFMR changes, suggesting that there are too few neighborhoods of opportunity in Chattanooga for payment standards to have a meaningful effect. In Cook County, the authors indicated that an aggressive private rental market may have limited access to neighborhoods of opportunity.

Inconsistencies in either the FMR or SAFMR and the private market rents can significantly affect housing outcomes. First, in areas where enough HCV housing adopts payment standards that

exceed the market rate, rents may be artificially increased above market rates expected in the absence of HCV housing (Collinson and Ganong, 2018; Susin, 2002). The mechanisms for this are unclear but likely involve a combination of reducing the supply of market housing (housing not enrolled in HCV) and reactions to price ceilings associated with payment standards. Price increases to market housing would reduce affordability for renters that do not have vouchers. Previous research in Allegheny County, PA, has found that subsidized housing (public housing and HCV units) can constitute a significant portion of affordable housing supply for individuals below the 50 percent area median income (Deitrick et al., 2011).

Conversely, if payment standards are lower than the market, landlords are more likely to prefer to rent on the private market and thus opt out of Section 8. Stakeholders have emphasized this particular concern in the transition to SAFMR in that small area markets will depress voucher amounts in low-rent areas, where most existing subsidized households are located, potentially resulting in decreases in the number of total subsidized units (Walter, 2018; Treat, 2018).

Palm (2018) used commercially available rental data (sourced from the same supplier of data for this study) to estimate the counts of eligible units before and after the administration of SAFMRs in five metropolitan areas in California. Except for San Francisco, Palm found that using SAFMR's increased eligible units in low-poverty areas and decreased eligible units in high-poverty areas, with net increases in total eligible units reported by metropolitan area. San Francisco reported a loss of eligible units throughout the city, where the author suggested rents were rising faster than could be recorded by the ACS.

If voucher amounts are higher than the market, then landlords will be more likely to participate in Section 8 but may overcharge (Desmond and Perkins, 2016; Collinson and Ganong, 2014; McClure, Schwartz, and Taghavi, 2015) or even manipulate the HCV process to effectively strand tenants (Rosen, 2014), thus decreasing the cost-effectiveness of subsidized housing and the number of total families who can be served.

It is not yet clear how well-subsidized housing can compete with the market in areas of opportunity. Previous studies have shown, however, that landlords experience real and perceived barriers to enrolling in the HCV program, including, but not limited to, financial risks, challenges of meeting HCV inspection requirements, and an incomplete understanding of HCV (Greenlee, 2014; Pashup et al., 2005). Moreover, many studies have found discrimination against voucher holders and vouchers as a source of income (Pendall, 2000; Turner and Ross, 2005; Yinger, 1995). It is unclear how such discrimination will influence movement to opportunity. One early study in Chicago found that voucher holders were 10 percent more likely to be denied housing in mixed-income communities targeted for new subsidized housing than those seeking housing throughout Chicago (Lawyers Committee for Better Housing, 2002).

It is also unclear to what extent existing HCV tenants are interested in moving to higher rent areas and under what circumstances they would move. Schwartz, Mihaly, and Gala (2017) conducted an experiment in which HCV voucher holders were offered a $500 grant and mobility counseling to make opportunity moves in Chicago, IL, finding that these incentives did not increase the share of opportunity moves beyond the control group, which was 12 percent. Schwartz, Mihaly, and Gala

suggested 12 potential barriers influencing opportunity moves, including increased transaction times (including search costs) to find units in opportunity areas, insufficient resources to move or rent units in opportunity areas, no landlord recruiting in opportunity areas, and too stringent standards for areas of opportunity.

Housing authority staff have also expressed concern about administering a payment standard that needs to conform to SAFMRs across many ZIP Codes. Walter (2018) examined the implications of aggregating ZIP Codes in San Antonio, TX; Fort Lauderdale, FL; and Jacksonville, FL, finding significant disparities between commercially available rents and allowable payment standards for aggregated ZIP Codes. Walter ultimately concluded that ZIP Codes were simply too aggregate to align with commercially available rent, even though this would make it more difficult for landlords and housing authorities to administer HCV housing and for tenants to "shop" for leases.

In a review of HUD's SAFMR rule changes, Treat (2018) recommends giving housing authorities more flexibility to use "local knowledge" when geographically defining small area markets and improving the accuracy of payment standards. This study follows these recommendations by comparing observed and modeled prices of 11,214 market rental listings for the city of Pittsburgh, PA, to SAFMR and FMRs by MSA in light of moving to opportunity policy objectives.

Materials and Methods

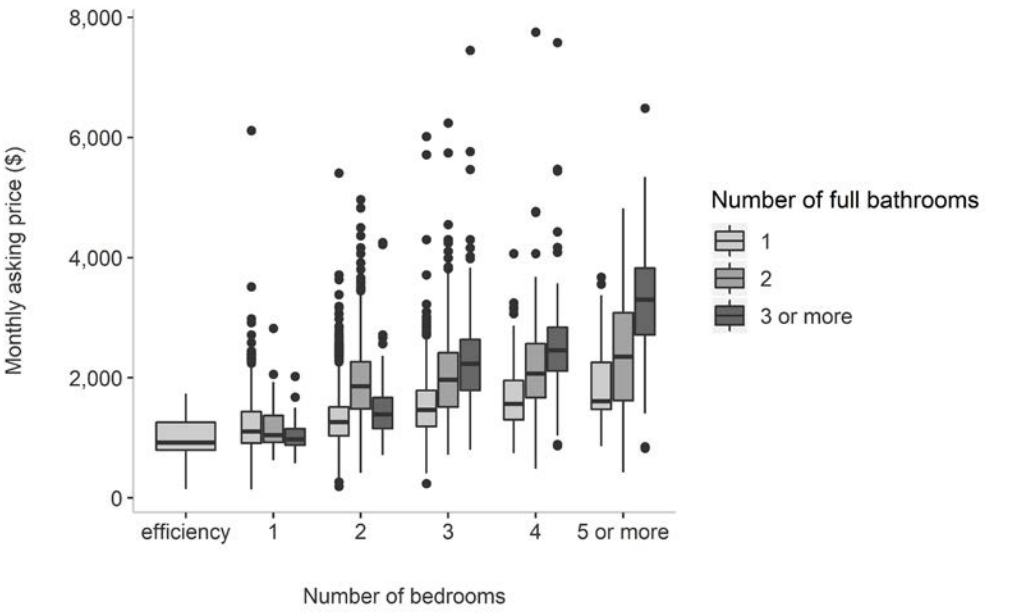
Data used for this analysis were purchased from Rent Jungle (Rainmaker Group, 2017), a commercial aggregator of rental market data. The raw data include 1,006,857 listings aggregated from different websites advertising online properties for rent in the city of Pittsburgh for October 2016 and October 2017. As a result of pooling listings from multiple sources and landlords that repeatedly list properties, the raw data include duplicate listings. Rent Jungle applies a proprietary algorithm intended to distinguish unique listings from duplicate listings. The expected number of available unique listings in the city of Pittsburgh should roughly match those estimated using tenure data for rental units (U.S. Census, 2019) or 16,500 listings. We found Rent Jungle's algorithm indicated approximately 30,000 unique listings, or twice those expected using Census data. As a result, we allow only one advertised prototype per address to eliminate duplicates, where a unit prototype is defined by unique counts of bedrooms and bathrooms, floor space (where available), and price. While these criteria would exclude listings with the same floorplan simultaneously listed at the same address, their application leads to approximately 15,000 unique listings available for rent, which better matches the 16,500 available units estimated using Census data.

In addition to triaging duplicate listings, we also removed listings that did not include bedroom and bathroom information and 53 outliers where the monthly asking rent was below $25 or above $10,000. The final sample used for analysis consists of 11,214 listings, thus representing approximately 68 percent of estimated available listings across 84 neighborhoods and 26 ZIP Codes in the city of Pittsburgh. Exhibit 1 summarizes variation in price by counts of bedrooms and bathrooms. Counts by bedroom size are 436 efficiencies; 2,158 one-bedroom units, 3,898 two-bedroom units; 2,831 three-bedroom units; 983 four-bedroom units; and 308 units with five or more bedrooms. Nearly 19 percent of addresses in the sample reflect multiple units available;

approximately 1 percent report more than 10 units available; and three addresses report more than 80 units available. These diagnostics suggest our criteria for identifying unique listings did not eliminate addresses presenting multiple listings.

Exhibit 1

Variation in Advertised Rent by Bedrooms and Bathrooms for 11,214 Listings in the City of Pittsburgh between October 2016 and October 2017



Gross rent—the rent value that includes both the lease amount and utilities—is the basis for HUD's fair market rent definitions (FMR and SAFMR). Combinations of the words "electric," "gas," "water," "utilities," "heat," "included," and "not" were used to identify listings likely to include utilities. Approximately 6 percent of listings in the Pittsburgh MSA were estimated as including utilities. None of these listings were in the city of Pittsburgh, however. Thus, expenditures on natural gas and electricity were estimated as the mean by bedroom and bathroom from pooled energy consumption survey data at broader geographic scales (urban homes in Pennsylvania taken from the U.S. Department of Energy [DOE], 2012; urban homes in the Middle Atlantic Census taken from DOE, 2018). Expenditures on water were estimated using water rates for the local Pittsburgh utility (PWSA, 2017) applied to a consumption of 62 gallons per capita per day (Dunham-Whitehead and Moya, 2007) and an average of 0.9 people per bedroom (DOE, 2012; DOE, 2018). On average, estimated utility expenditures resulted in electricity, natural gas, and water contributing to 5.4 percent, 2.5 percent, and 3.6 percent of gross rent, respectively, or a total share of 11.5 percent of gross rent spent on utilities.

To approximate spatial boundaries in rental markets, we first regress market prices in the Rent Jungle sample (n = 11,214) against bedrooms and counts of bathrooms (modeled as nominal variables shown in exhibit 1 and as continuous variables using equation 1).

(1) $$log(price) = B0 + B1 * beds + B2 * baths + B3 * beds * baths + \varepsilon$$

In equation 1, the error (or residuals) term ε encompasses all contributions to market prices not explained by counts of bedrooms and bathrooms. Much—but not all—of these contributions will include renters' valuations of spatial amenities, such as access to transit. In order to approximate spatial boundaries in rental markets, we then cluster (k-means) the listings latitude, longitude, and residuals (ε) from equation 1 to estimate small area markets. The k-means clustering algorithm characterizing the "closeness" of listings with respect to space (latitude and longitude) and residual (ε) which largely represents spatial amenities.

We test between 2 and 26 clusters, as there are 26 unique ZIP Codes in the city of Pittsburgh. The initial cluster assignments provide point estimates indicating the cluster with which the listing is associated. Such point estimates derived from the Rent Jungle sample are helpful but do not completely account for all units that could potentially participate in the HCV program. To derive spatially continuous, complete coverage across the city, we assign to each parcel the most frequent cluster associated with its 50 nearest rental listings in our sample, which, in turn, involved re-assigning the cluster for some observations. We then regress listing prices according to equation 2.

(2) $$log(price) = B0 + B1 * beds + B2 * baths + B3 * beds * baths + B4 * geography + \varepsilon$$

In equation 2, the geography was modeled using either ZIP Codes, the initial cluster assignment, or the clusters reassigned based on its nearest neighbors to evaluate the efficacy of different geographic representations of small area markets. Both geographic definitions (ZIP Codes, initial clusters, and reassigned clusters) and cluster counts were evaluated using the model adjusted R-squared estimated from applying the sample to equation 2.

We compare observed and fitted rents to the SAFMRs and FMRs[1] for the city of Pittsburgh (HUD, 2019b; HUD, 2019c) based on consistency, counts of households eligible for assistance, and differences in the estimated price. For point comparisons, we assume all payment standards are equal to 100 percent of SAFMRs or FMRs. Where ranges are compared, we assume payment standards vary from 90 percent to 110 percent of SAFMRs. Where fitted results were used as a comparison, the model fits reported herein were randomly drawn from the fitted mean and standard deviation, assuming the fitted results are normally distributed.

To estimate the effect of the SAFMR transition on a broader group of properties that could participate in HCV, we also applied our models to all 1–4 bedroom units not in large multi-family complexes, where the stock and location of 1–4 bedroom units were taken from Allegheny County (2018). This broader group of properties include 98,090 or approximately 73 percent of households in Pittsburgh (U.S. Census, 2019). In broadening our model to other potential HCV properties, we excluded multi-family complexes because the available data (Allegheny County, 2018) do not list bedroom and bathroom counts for each unit in multi-family complexes.

Analysis and results were prepared using the R programming language (R Core Team, 2018) in the R Studio software (RStudio Team, 2018), including using R packages authored by Wickham et. al.

[1] The 2017 FMRs used for this study are those for the Pittsburgh HMFA geography.

(2019), Wickham (2016), and Zhu (2018).

Exhibit 2

Data Sources and Their Respective Geographic and Property Scopes Relevant for this Study

Data Set or Rent Benchmark	Smallest Available Geography Resolution	Scope of Properties Relevant for this Study	
		Geography	Properties Represented
Market Rents	Individual Unit	City of Pittsburgh	All Online Listings in Rainmaker (2017) that Meet the Criteria Described Herein
Small Area Fair Market Rent (SAFMR)	ZIP Code	City of Pittsburgh	All Rents Reported to the U.S. Census (see HUD, 2019c for Details)
Fair Market Rent (FMR)	HUD Metro Fair Market Area (HMFA)	HUD Metro Fair Market Area (HMFA)	All Rents Reported to the U.S. Census (see HUD, 2019b for Details)
Property Tax Assessments	Parcel	City of Pittsburgh	All Property Types Equal to or Smaller than Four-Family Units (Allegheny County, 2018)

Results

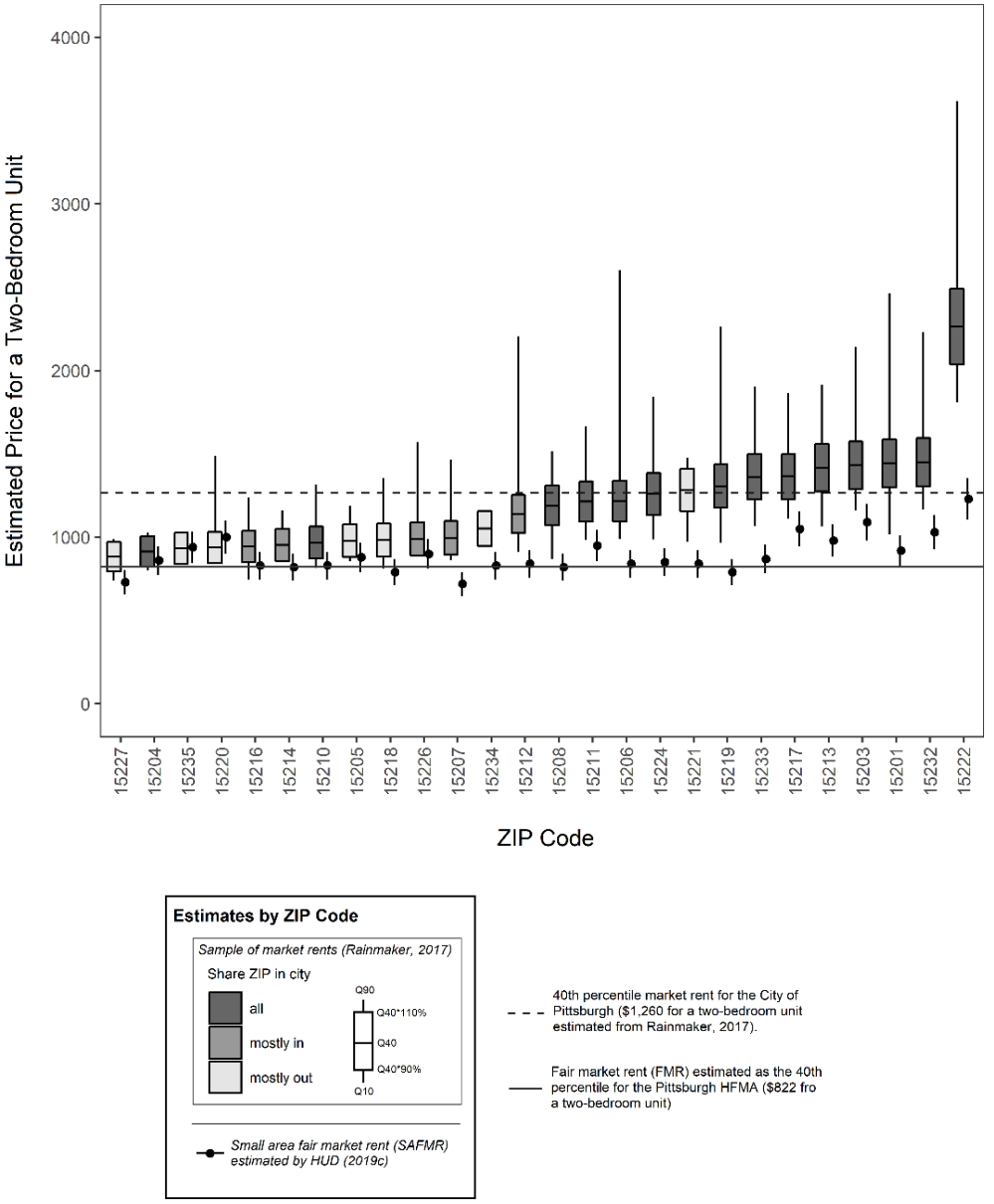
Exhibit 3 compares distributions of two-bedroom market rents with SAFMRs for two-bedroom units by ZIP Code. We limit the presentation of results to two-bedroom units for clarity. Two-bedroom units were the most frequently occurring unit size and largely represent trends observed for units of other sizes. Exhibit 3 indicates that SAFMRs are below the corresponding 40th percentile market rents for all ZIP Codes except 15235 and 15220. The market estimate tends to be increasingly higher than the SAFMR with increasing market price. Exhibit 3 indicates ZIP Codes crossing the city boundary may explain some of the discrepancies between listed rents; however, the most extreme differences occur where ZIP Codes do not cross city boundaries. Exhibit 3 also indicates that variation within ZIP Codes is much more significant in high-rent ZIP Codes completely contained by the city (see legend titled "Share ZIP in the city" in exhibit 3).

HUD's constraining SAFMR definitions to within 50 percent to 150 percent of the parent FMR (the 40th percentile FMR criteria) is likely influencing the degree to which market rents exceed the SAFMR in very high-rent markets (for example, 15222).

Exhibit 4 shows the adjusted R-squared estimated when applying equations 1 and 2 assuming different geographic variables during regression. As a point of reference, the correlation between the market data and SAFMR is approximately 37 percent, which is marginally better than the variation in SAFMR explained solely by bedrooms and bathrooms (the R-squared for equation 1 is 35 percent). Modeling spatial amenities using ZIP Codes as a proxy (applying equation 2 with ZIP Codes equal to geography) increases the adjusted R-squared to 50 percent. The model improves

Exhibit 3

Variation in Market Rent for Two-Bedroom Units by ZIP Code in the City of Pittsburgh Compared to Fair Market Rents Published by HUD

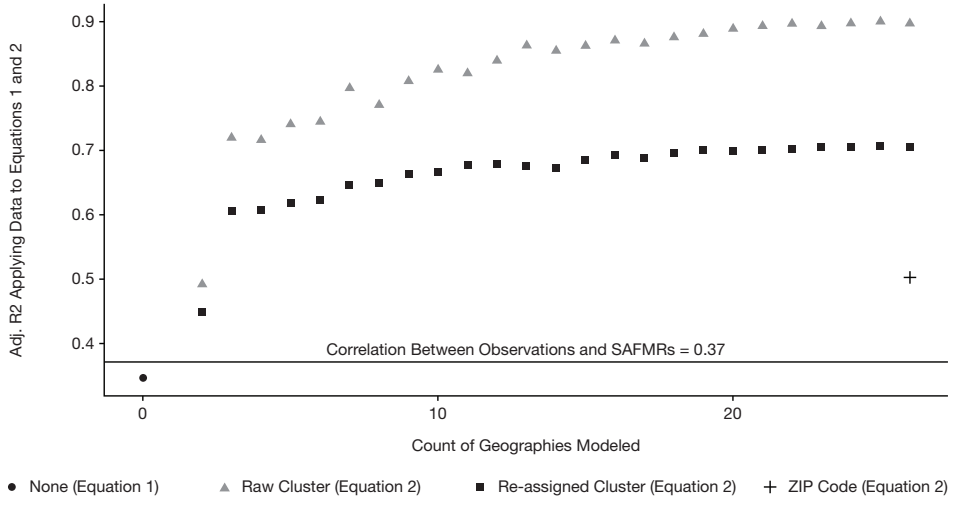


Note: Rents reflect 11,214 listings advertised online between October 2016 and October 2017 (Rainmaker, 2017). The fair market rents published by HUD include the FY17 SAFMRs (HUD, 2019c) and 40th percentile for Pittsburgh FMR (HUD, 2019b). The variable "share ZIP in city" reflects those ZIP Codes completely contained by the city (a value of "all"), ZIPs whose area is 50 percent or more in the city (a value of "mostly in"), and ZIP Codes whose area is more than 50 percent outside of the City ("mostly out").

considerably, however, when spatial amenities are modeled by cluster. Compared with modeling all 26 ZIP Codes in Pittsburgh, only 2 clusters are needed to improve on the ZIP Code model. Moreover, if 26 clusters are assumed, the adjusted R-squared values are 90 percent and 71 percent assuming initial cluster assignments and clusters reassigned using nearest neighbors, respectively.

Exhibit 4

Adjusted R-Squared Applying Sample to Equation 1 and Equation 2 Assuming Different Geographic Variables Represent Spatial Amenities



Note: Equation 1 does not include spatial amenities. Equation 2 assuming spatial amenities are represented by either ZIP Codes or clusters estimated using k-means, where both original cluster assignments and clusters re-assigned by nearest neighbors where modeled.

For subsequent analysis, we select a model with eight clusters that have been reassigned using nearest neighbor, which led to re-assigning the cluster for approximately 12 percent of the observations. Exhibit 5 summarizes this model. The selected model is relatively simple and administratively feasible given it covers the entire city and is reasonably predictive with an adjusted R-squared of 65 percent, which is considerably higher than the correlation between the SAFMR and market rents of 37 percent. Increases in R-squared beyond eight clusters are marginal (see

exhibit 4). The goal of this analysis is not to prescribe the number of clusters that Pittsburgh should employ but demonstrate how these data can be useful in transitioning to SAFMR.

Exhibit 5

Regression Results from Fitting the Sample to Equation 2 Assuming Eight Clusters

Variable	Estimate	Std. Error	P-value
(Intercept)	6.27	0.021	<0.001
Bedroom—1	0.34	0.023	<0.001
Bedrooms—2	0.37	0.021	<0.001
Bedrooms—3	0.52	0.022	<0.001
Bedrooms—4	0.62	0.027	<0.001
Bedrooms—5 or more	0.71	0.026	<0.001
Bathrooms	0.18	0.015	<0.001
Cluster 2	0.10	0.011	<0.001
Cluster 3	0.24	0.010	<0.001
Cluster 4	0.25	0.010	<0.001
Cluster 5	0.36	0.010	<0.001
Cluster 6	0.59	0.010	<0.001
Cluster 7	0.62	0.010	<0.001
Cluster 8	0.70	0.012	<0.001
Bedroom—1:Bathroom	-0.16	0.019	<0.001
Bedrooms—2:Bathrooms	-0.02	0.017	0.262
Bedrooms—3:Bathrooms	-0.01	0.016	0.414
Bedrooms—4:Bathrooms	-0.02	0.018	0.339

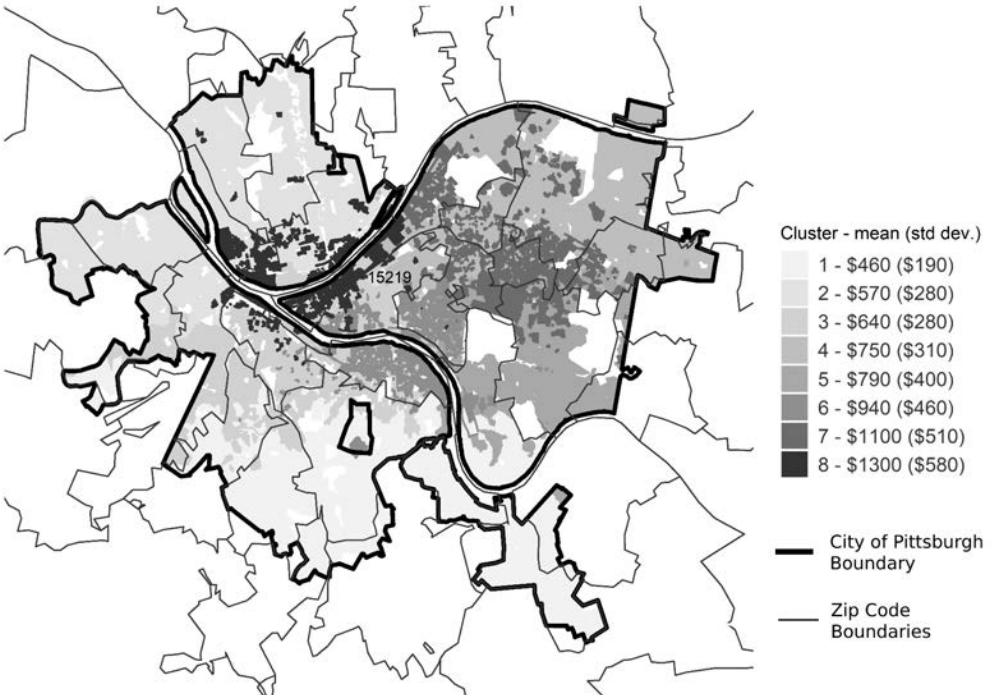
Notes: The initial cluster assignments were reassigned using nearest neighbors to ensure continuous and complete geographic coverage. Residual standard error: 0.23 on 11196 degrees of freedom. Adjusted R-squared: 0.649. F-statistic: 1220.06 on 17 and 11196 DF with a p-value < 2.2e-16.

Exhibit 6 maps the clusters from the selected model against ZIP Codes. Exhibit 6 indicates that ZIP Codes rarely align with the cluster boundaries and are more likely to contain a complete cluster at the outskirts of the city where geographic variation in cluster assignment is relatively low. Exhibit 6 also indicates more variation in cluster assignments for those ZIP Codes completely contained by the city, which include those areas in Pittsburgh that are more commercially active. For example,

ZIP Code 15219—which is between the most commercially active neighborhoods in the city—encompasses six of eight clusters.

Exhibit 6

Map of Spatial Clusters of Market Rents Compared with ZIP Code Boundaries



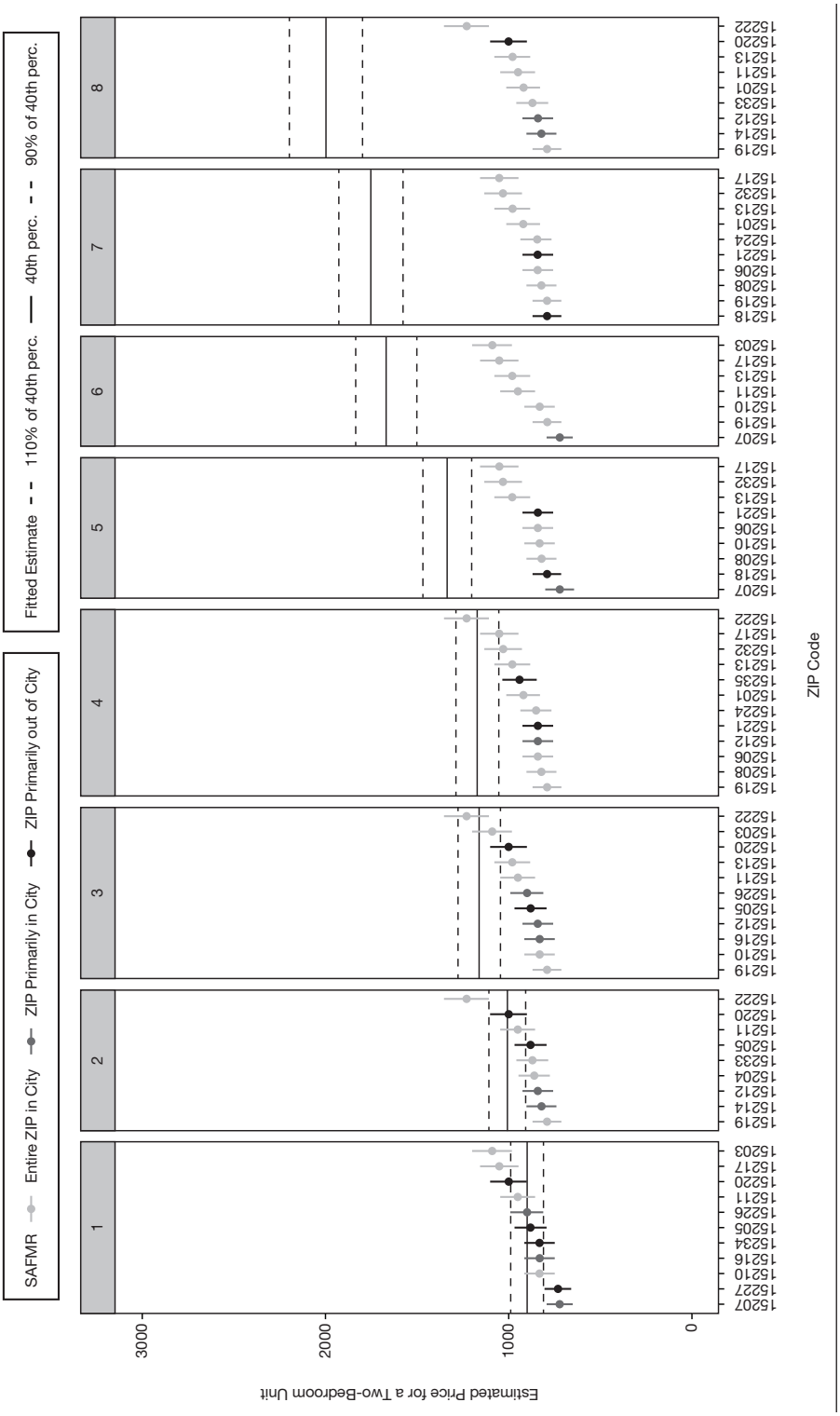
Note: Example ZIP Code 15219 is relatively centrally located and includes six different clusters, an example demonstrating that market rent variation within ZIP Codes is more pronounced near the city center.

Exhibit 7 also suggests that markets can be extremely small, extending only several blocks in some cases. This occurs even after smoothing out discontinuities using nearest neighbors. While it is beyond the scope of this study to identify the contributions of spatial amenities to rents, readers familiar with Pittsburgh will note several potential causes for these micro markets, including access to transportation, green space, rivers, or entertainment.

Exhibit 7 compares SAFMRs with prices fitted to all two-bedroom units (Allegheny County, 2018) applying equation 2 to the selected model of eight clusters derived by re-assigning the initial clusters using nearest neighbors. Exhibit 7 indicates that the fitted rents match relatively well the SAFMR for clusters 1 and 2. The fitted rents match SAFMRs for only a few ZIP Codes that overlap clusters 3 and 4. In clusters 5 through 8, which include the high-rent areas, SAFMRs are biased

Exhibit 7

Fitted Rents for Market Two-Bedrooms Compared with Two-Bedroom SAFMR



low such that the allowable high payment standard (110 percent of the 40th percentile by ZIP Code) are all below 90 percent of the 40th percentile of the fitted estimates.

Exhibit 8 compares the distribution of listings with rents below the FMR and SAFMRs for Pittsburgh, PA, to the (a) all 1–4 bedrooms in the Rent Jungle sample (11,214 potentially eligible units) and (b) the modeled estimates for all 1–4 bedrooms (98,090 potentially eligible units). Exhibit 8 suggests that the SAFMR does achieve the goal of increasing eligible units in higher rent areas. The increase in eligible units, however, declines considerably with increasing rent. Using fitted values for all 1–4 bedroom units (exhibit 8b), the transition from FMR to SAFMR increases by eligible units in the two highest rent clusters from 20 (7 + 13) to 66 (47 + 19), which accounts for less than 1 percent of total units in these two clusters. In contrast to the highest rent clusters, an increase in 4,400 units (2,500 + 1,900) is estimated for the lowest two clusters, which accounts for 22 percent of the total units in these two clusters. More importantly, the price differences between the SAFMR and the market rents vary considerably in magnitude between low- and high-rent

Exhibit 8

Total Counts of Households, Counts of Households Eligible for the HCV Program, and the Difference in Market and SAFMR Price by Cluster for (a) the Sample of Market Rents and (b) All One- to Four-Bedroom Units

a.	Counts of Observations as Summarized in Exhibit 1					Compare SAFMR with Market Prices		
Cluster	Total Units	Observed Price Less than FMR	Observed Price Less than SAFMR	Change in Eligible Units	Change in Eligible Units Relative to Total Units	Mean Observed Price	Mean (SAFMR-Observed Price)	Difference Relative to Mean Observed Price
1	710	97	170	71 (180%)	10%	1,000	-110	-11%
2	1,000	110	220	110 (200%)	11%	1,100	-190	-17%
3	1,600	21	170	150 (810%)	9.10%	1,300	-290	-22%
4	1,900	71	130	62 (180%)	3.30%	1,300	-360	-28%
5	1,300	3	92	89 (3100%)	6.80%	1,500	-400	-27%
6	1,300	2	12	10 (600%)	0.77%	1,900	-800	-42%
7	1,900	22	39	17 (180%)	0.89%	1,900	-940	-49%
8	840	3	8	5 (270%)	0.60%	2,000	-1,000	-50%

b.	Counts of All 1–4 Bedrooms*					Compare SAFMR with Market Prices		
Cluster	Total Units	Fitted Price Less than FMR	Fitted Price Less than FMR	Change in Eligible Units	Change in Eligible Units Relative to Total Units	Mean Fitted Price	Mean (SAFMR-Fitted Price)	Difference Relative to Mean Fitted Price
1	21,000	4,400	6,900	2,500 (160%)	12%	1,000	-100	-10%
2	19,000	2,000	3,900	1,900 (200%)	10%	1,200	-200	-17%
3	13,000	470	1,800	1,300 (380%)	10%	1,300	-310	-24%
4	18,000	590	1,400	820 (240%)	4.60%	1,400	-400	-29%
5	11,000	110	740	640 (670%)	5.80%	1,600	-540	-34%
6	4,500	6	69	63 (1200%)	1.40%	1,800	-770	-43%
7	9,000	13	47	34 (360%)	0.38%	2,100	-1,100	-52%
8	2,900	7	19	12 (270%)	0.41%	2,100	-1,100	-52%

Note: Units estimated as eligible for the HCV program assuming payment standards of 100 percent of FMR and SAFMR. The sample of market rents in exhibit 8a are those summarized in exhibit 1. The sample of units included in exhibit 8b includes one- to four-bedroom units in properties equal to or smaller than "four family" units as described by Allegheny County (2018). Fitted values were randomly assigned estimates within two standard deviations of the mean fit. Estimates rounded to two significant figures for clarity.

clusters. The SAFMR payment standard in low-rent clusters is approximately 10 percent below market rent, but more than 50 percent below market rent in high-rent areas.

Conclusions and Implications

Since its conception, affordable housing stakeholders have expressed concern about using ZIP Codes and latent American Community Survey (ACS) rent data as the basis for defining small area markets to define payment standards under HUD's Housing Choice Voucher (HCV) program. Inherent in the use of ZIP Codes to represent small area markets are prima facie concerns about misalignment with spatial amenities and the inclusion of rents from nearby but otherwise unserved municipalities as the basis for payment standards. Concerns about ACS data include representativeness and latency.

This study uses market rents in Pittsburgh, PA, to define small area markets and explore the implications of inconsistencies between market rents and Small Area Fair Market Rents (SAFMRs) and Fair Market Rents (FMRs). While correlations between market rents and SAFMRs are relatively low at 37 percent, correlations using markets derived from a combination of clustering and nearest neighbor algorithms can be as high as 71 percent. The model selected for this study includes only eight clusters, which is fewer than the 26 ZIP Codes in Pittsburgh, demonstrated by an adjusted R-squared of 65 percent.

Results suggest that the SAFMR achieves its goal of increasing the eligible units relative to HUD's previous standard using FMRs. Unlike previous studies using the same commercial data set, however, increases in eligible units were observed in all areas but were disproportionately in lower rent areas. The change in standard increased by only 46 eligible 1–4 bedroom units in the two highest rent areas. While this is a 330-percent absolute increase (from 20 to 66) the increase represents only 1 percent of total units.

The SAFMR is below the market rent in all ZIP Codes and generally increasingly so with the increasing rental price. All else equal, differences between market rent and the voucher amounts allowable under HUD's requirements are likely to affect landlords' willingness to participate in the HCV program. A competitive payment standard combined with a high count of eligible units is likely to increase HCV landlords in low-rent markets and, in some marginal units, may enhance established landlord behaviors of overcharging or manipulating the HCV program to make it more difficult for existing voucher holders to move. If landlords see an opportunity to overcharge in low rent areas, this SAFMR payment standard may increase HCV housing and, therefore, expenditures of public resources in low-rent areas.

High-rent markets demonstrate very few increases in eligible units combined with payment standards well below market rents. Thus, only landlords that have trouble renting to the private market, such as those that offer properties of marginal quality, are expected to participate in the HCV program. It is not fully clear how landlords and tenants will interact in leasing marginal properties in high-rent areas, but these findings suggest that search costs for tenants will be higher in high-rent neighborhoods. Moreover, it is also unclear how tenants will trade better onsite amenities in low-rent areas, such as a yard, with the neighborhood amenities typically associated

with the area of opportunity. These trade-offs are important given that the few properties in high-rent areas expected to become eligible under the proposed SAFMR standards are expected to be of marginal quality (assuming prices partly reflect quality). These results may explain previously observed declines in high-rent areas following the introduction of SAFMR into some markets (Reina, Acolin, and Bostic, 2019).

ACS ZIP Code rent data from nearby but otherwise unserved municipalities appears to not be significantly influencing inconsistencies between market rents and SAFMRs unless rents from these nearby municipalities are simply compensating for other inaccuracies in the payment standard. Conversely, it is not clear why the payment standards are biased low in higher rent areas associated with ZIP Codes completely within the city. Misalignment between the SAFMR and the market rents may be due to HUD's restricting SAFMRs to within 50 percent and 150 percent of the FMR. Future work should explore the potential misrepresentations of market rent introduced by the 50-percent to 150-percent FMR restriction. It could be that the ACS data are latent or simply inaccurate or that the market data are biased upward. Results do suggest significantly more variation in rent in high rent areas in ZIP Codes completely contained by the city, suggesting micro markets appear closer to areas of high commercial activity.

This study indicates that rental markets in Pittsburgh can be extremely local, extending for only several blocks in many locations. The underlying amenities (for example, access to education, transit, entertainment) reflected in these observations are speculative, but distinguishing their contribution to rental prices could better help interested families move to areas of opportunities. By better understanding the contributions of individual amenities to market rents, housing authorities could theoretically prioritize subsidies to towards amenities more aligned with opportunity (for example, access to education or employment).

As previously reported by Palm (2018), the use of proprietary rental data, such as those employed in this study, in administering an HCV may not be feasible in that these data do not conform with the Government Accountable Office standards transparency, reproduction, and geographic consistency (GAO, 2005). These data could, however, guide improved data collection by HUD or the Census Bureau in support of moving to opportunity. There are also limitations to the raw Rent Jungle data, including, but not limited to, demonstrating an uncertain degree of duplicate listings, too limited coverage of onsite amenities outside of bedrooms and bathrooms (for example, floor space), and no sampling procedure such that the data may be unrepresentative.

Similarly, it should be noted that future work should explore other spatial clustering methods outside of k-means, such as including a distance function that attenuates the contribution of neighboring rents with distance or methods that reflect stark geographical barriers (for example, rivers and hillsides) characteristic of Pittsburgh.

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