Household Energy Bills and Subsidized Housing

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Abstract

Household energy consumption is crucial to national energy policy. This article analyzes how the rules covering utility costs in the four major federal housing assistance programs alter landlord and tenant incentives for energy efficiency investment and conservation. We conclude that, relative to market-rate housing, assistance programs provide less incentive to landlords and tenants for energy efficiency investment and conservation, and utilities are more likely to be included in the rent. Using data from the American Housing Survey, we examine the differences in utility billing arrangements between assisted and unassisted low-income renters and find that—even when controlling for observable building and tenant differences—the rent that assisted tenants pay is more likely to include utilities. Among all tenants who pay utility bills separately from rent, observable differences in energy expenses for assisted and unassisted tenants are driven by unit, building, and household characteristics rather than the receipt of government assistance.

Introduction

Federal housing policy emphasizes both sustainability and affordability (EPA, 2009; HUD, 2010); household energy use is central to both of these priorities. The federal government provides some form of subsidy for more than 6 million affordable housing units, largely through the four major housing programs: public housing, project-based Section 8, the Low-Income Housing Tax Credit (LIHTC) Program, and tenant-based Section 8 (vouchers). This article analyzes how the treatment of utility costs in these programs shapes incentives for energy efficiency investments and conservation. We focus particularly on how program design influences whether utilities are included in the

rent or paid for separately by assisted tenants.[1] We then use the American Housing Survey (AHS) to compare tenant expenditures and utility billing arrangements for gas and electricity among low-income households that do and do not report receiving government housing assistance.

We argue that the reimbursement of utility costs in the major federal housing programs leaves landlords with less incentive to contain costs or improve energy efficiency and more incentive to include utilities in the rent than their private market counterparts. When utilities are included in the rent, assisted tenants have no financial incentives to conserve energy. In contrast, when assisted tenants pay for energy usage separately from the rent, they face the marginal costs of their consumption, much like unassisted tenants in the private market whose utilities are not included in the rent.

Using data from the AHS, we show that respondents who are assisted tenants (who, by program design, have low incomes) report that their utilities are included in the rent more often than unassisted renters who fall into similar income categories. This difference is robust to controlling for observable differences in the characteristics of the buildings of residence and of the respondents. For example, we find that for households that report living in a building owned by a public housing authority (PHA), the share of households for which utilities are included in the rent is 21 percentage points higher for electricity and 10 percentage points higher for gas compared with unassisted tenants, after controlling for observable building and tenant characteristics. Tenants who report receiving assistance in the form of vouchers also report having utilities included in the rent more often than those reporting no subsidy, although the difference is less dramatic than for other forms of household assistance. Although we do not observe consumption or energy efficiency investments in our data directly, we are able to examine reported utility expenditures for households paying utility bills separately from the rent. For this group, we find that observable differences between assisted and unassisted households in mean spending on utilities are attributable to differences in characteristics of the units, buildings, and households rather than receipt of government housing assistance.

This work is motivated by the broader questions of how household energy use responds to price incentives and how the treatment of utility costs in affordable housing programs supports policy goals. The U.S. Department of Housing and Urban Development (HUD) administers federal affordable housing programs as part of its mission to promote "quality affordable homes for all."[2] HUD's housing policy also includes minimizing the environmental impacts of residential energy consumption, as exemplified by the agency's $50 million energy innovation fund, a key component of HUD's sustainability strategy. Household spending on utilities interacts with housing affordability; utility costs may represent a large share of low-income household budgets (HUD, 2000). In addition, HUD's annual spending on public and subsidized housing includes $5 billion for energy (HUD, 2009b). Energy efficiency and conservation gains may present a significant opportunity for savings or resource redirection in a time when the agency is facing significant cuts (HUD, 2011a).

[1] Throughout this article, we use the term "assisted tenants" to explicitly distinguish tenants receiving (or, in the empirical section, reporting receipt of) assistance in one of the four housing programs from "unassisted tenants" who rent in the private market with no (reported) assistance. When applicable, we identify the program from which assisted tenants receive assistance.

[2] HUD's mission statement on http://hud.gov.

Landlords and developers influence energy consumption through energy efficiency investments, maintenance, the appliances they include in units, and whether they offer rent with utilities included (Davis, 2010; Levinson and Niemann, 2004). Renters consider billing arrangements and expected utility costs, among other factors, when choosing an apartment. In addition to these choices that landlords, developers, and tenants make, realized energy consumption also depends on residential utility rates and the characteristics of the residence and the household. The treatment of utility costs in affordable housing programs may alter the incentives framing these choices for both landlords and assisted tenants. This article introduces this potential differential in incentives between assisted and market-rate housing as an opportunity to examine renter and landlord choices that determine energy use and analyze the outcomes of housing policy in this regard. It also contributes to research that informs housing policies that promote affordability while encouraging energy efficiency and conservation.

Utility Costs and Affordable Housing Programs

Federal, state, and city governments have created programs that provide or promote affordable rental options for low- and moderate-income Americans. These programs range from rental units owned and managed by government agencies to voucher programs that subsidize the rent of low-income tenants in privately owned properties. The wider literature has explored many effects of housing assistance. For example, Shroder (2002) reviews the literature on whether housing assistance hinders the self-sufficiency of assisted families, and Khadduri, Burnett, and Rodda (2003) review the literature regarding the most effective use of government subsidies in producing rental housing. Our analysis adds to this literature by examining the interaction between assisted housing programs and utility billing arrangements and expenditures. We begin by describing how the four major federal housing assistance programs treat utility expenses. Public housing, project-based Section 8, LIHTC, and voucher programs together provide the bulk of government housing assistance in the United States. Exhibit 1 compares the size and basic administration of these programs.

The federal government began to fund public housing development with the 1937 Housing Act (Stoloff, 2004). In the late 1960s, federal policy shifted away from public housing in favor of voucher programs and subsidies to privately owned, income-restricted developments. Recent decades have seen the demolition of some public housing and few additions to the overall supply. As of 2009, approximately 1.13 million public housing units existed in the United States (HUD, 2009a).

Exhibit 1

Federal Rental Housing Assistance Programs

Program	Units (millions)	Administering Agency	Funding Agency
Public housing	1.13	Local public housing authority	HUD
Project-based Section 8	1.28	Contract administrator or HUD regional office	HUD
LIHTC	1.70	State and/or local allocating agency	Tax expenditure
Tenant-based Section 8 (voucher)	2.09	Contract administrator or HUD regional office	HUD

HUD = U.S. Department of Housing and Urban Development. LIHTC = Low-Income Housing Tax Credit Program.

Note: Unit counts taken from HUD (2009a) "HUD Assisted Housing Units by Program" table.

Local PHAs own and manage public housing developments. The rent paid by assisted tenants living in public housing is based on tenant income. The development's funding agency, which is usually HUD, covers additional operating costs. In some developments, PHAs pay utility costs not included in the rent from their own operating budgets. When all utilities are included in the rent, assisted tenants in public housing pay 30 percent of their income in rent. At the end of every year, the housing authority submits its utility costs to HUD as part of the subsequent year's funding request. HUD compares the year's utility costs with the average utility costs for the previous 3 years. If costs decreased, HUD adjusts the subsequent year's utility cost funding downward by 25 percent of the decrease; if the utility costs are higher, HUD increases subsequent funding by 25 percent of the increase.[3] Variability in utility costs that may result from energy price fluctuation or a PHA's efficiency and conservation initiatives is absorbed elsewhere in PHA budgets. The extent to which changes in energy expenses affect a PHA's operating budget, and subsequently a PHA's energy efficiency investments and conservation efforts, is a research question that would require analysis of HUD or PHA administrative data. Within the scope of this article, we note that these partial budget adjustments represent a potential cost or benefit to PHAs of including utilities in assisted tenants' rents, depending on energy price variability and opportunities for efficiency or conservation improvements.

In other public housing developments, assisted tenants pay some or all of their utility bills separately from rent. Every year, the local PHA develops a utility allowance schedule based on typical household utility bills in the area. The allowance is a flat amount, based on the number of bedrooms in a unit. For example, in 2010, the New York City Housing Authority set the monthly utility allowance for gas and electricity at $71 for a one-bedroom apartment in an elevator building.[4] When an assisted tenant in public housing pays utilities, the rent—originally 30 percent of income—is decreased by the unit's applicable utility allowance. The assisted tenant keeps or pays the difference, depending on whether the incurred bill is more or less than the utility allowance. If utility costs rise by more than 10 percent during the year, the PHA may adjust the allowance before the annual budget review.

The project-based Section 8 program was developed under the Housing and Community Development Act of 1974. In this program, private owners and developers contract with HUD to reserve a fraction of a building's units for low-income tenants. HUD sets local income limits that determine what constitutes "low-income"—typically 80 percent of Area Median Income (AMI). In these units, assisted tenants pay 30 percent of their income in rent, and HUD pays the landlord the difference between the assisted tenant's payment and HUD's approved rent, which is based on a local Fair Market Rent (FMR).[5] Approximately 1.28 million project-based Section 8 housing units existed across the country as of 2009 (HUD, 2009a).

[3] 24 Code of Federal Regulation (CFR) § 990.110.

[4] New York City Housing Authority Section 8 Assistance General Information: Voucher Payment Standards. Available at http://www.nyc.gov/html/nycha/html/section8/voucher_payment.shtml.

[5] HUD calculates FMR for each metropolitan area using the Office of Management and Budget's definition of a metropolitan area. HUD uses various inputs to calculate each metropolitan area's FMR, including the census, American Community Survey data, and the Consumer Price Index (*HUD Register* Vol. 75, No. 191, 2010). Nonprofits own many project-based Section 8 properties. In these cases, HUD bases rents on operating costs, capped at FMR, except for high market areas, which can go above FMR.

Similar to those in public housing, some assisted tenants in the project-based Section 8 program have utilities included in the rent and others pay utilities separately. However, some key differences exist in implementation between the two programs. When utilities are included in the rent, project-based Section 8-assisted tenants pay 30 percent of their incomes in rent, and the additional HUD subsidy to the landlord includes the difference between the assisted tenant's payment and HUD's approved rent plus utility costs. An owner initially establishes utility costs based on similar buildings but is able to adjust that amount based on actual costs in subsequent years. If utility costs are higher than in the previous year, an owner can submit a rent adjustment request based on the higher costs. Because project-based Section 8-assisted tenants' rents are capped at 30 percent of their incomes, the adjustment results in a larger subsidy from HUD. HUD expects owners to submit cost reimbursement adjustments every year, including years in which costs decline. In practice, most owners ask for adjustments less frequently than once a year (Goodman and Wolsky, 2011). Profit motives suggest that owners are more likely to request adjustments in years with relatively high utility costs, when reimbursements would be increased.

When the assisted tenant pays utilities and rent separately in a project-based Section 8 property, the assisted tenant's rent payment is discounted by a utility allowance. Each month, an assisted tenant pays the owner 30 percent of his or her income, minus the utility allowance, and HUD subsidizes the remaining approved rent. The assisted tenant's utility allowance is based on an analysis of recent utility costs in the area, adjusted for the number of bedrooms in the unit, and may be further adjusted to reflect individual building costs.[6] These building-specific utility allowance adjustments often require assisted tenants to provide landlords with utility bills and landlords to then submit the bills to HUD for verification of the building-specific average utility cost per unit. As in public housing, project-based Section 8 assisted tenants face the marginal cost of their consumption in this scenario. Again, cost motives suggest that assisted tenants in the project-based Section 8 program are more likely to submit their bills only in years with high utility costs, when allowances would be increased. In addition, landlords might view collecting bills as an unreimbursed administrative cost that provides them no financial benefit.

The LIHTC Program, created in 1986, gives tradable tax credits to developers who build or rehabilitate affordable housing. More than 1.7 million LIHTC units exist nationally (HUD, 2011b). For a project to qualify for LIHTCs, for the first 30 years of the building's operation, households with incomes of 50 percent or less of the AMI must occupy at least 20 percent of the project's units, or households with incomes of 60 percent or less of the AMI must occupy 40 percent of the units. Either the assisted tenant or the landlord can pay the utilities in a LIHTC property. Most LIHTC properties, however, have billing arrangements in which the assisted tenant pays at least some of the utilities (Montesinos, 2011).

Rent and utility allowance rules for LIHTC properties differ from those of the other programs. The state or local agency administering the credit caps rents at no higher than 30 percent of the monthly household income each property is targeting. A tenant's individual income determines eligibility for a unit but not the amount of the monthly rental payment. Because the local administering agency

[6] 24 CFR § 880.610.

establishes rents annually, the utility allowance is the only local variation in maximum rents for the low-income units in two properties targeting the same income band. An owner can use a utility allowance that is set by the local PHA, by the administering agency, or by a professional who analyzes costs for the previous year.[7] If the LIHTC-assisted tenant pays utility bills separately from rent, the owner must reduce the rent by this utility allowance and the assisted tenant must pay the actual billed costs of utility consumption from this allowance. Accordingly, the assisted tenant benefits if actual costs are less than the allowance but must pay out of pocket for any utility costs that exceed the allowance. When utilities are included in the rent, the owner receives the normal LIHTC rent from the assisted tenant and utility costs are part of landlord operating expenses. In this scenario, fluctuations in utility costs directly affect the landlord's bottom line.

HUD's Section 8 voucher program provides a subsidy that low-income voucher recipients can use toward any privately owned rental unit with a rent at or below the "voucher rent," usually 110 percent of FMR, set by the local PHA. More than 2 million U.S. households were receiving vouchers as of 2009 (HUD, 2009a).

For the voucher program, the local PHA establishes a utility allowance based on citywide averages and projected utility rate changes, again adjusted by the number of bedrooms in a unit. If utilities are not included in the rent, the voucher-assisted tenant pays the landlord 30 percent of his or her income, minus the utility allowance, and HUD pays the remaining rent each month. If the owner pays for utilities, HUD's payment includes the utility allowance, and the assisted tenant pays 30 percent of his or her income in rent. In principle, the amount HUD pays the landlord is the same in either scenario, with the assisted-tenant payment decreased by the utility allowance amount when utilities are paid separately. The local PHA will adjust rents and utility allowances annually based on the previous year's market trends and costs, but it will adjust the utility allowance more frequently if utility costs increase more than 10 percent during the year (HUD, 2001).

Incentives for Billing Arrangement and Utility Consumption

Our review of the treatment of utility expenses in housing assistance programs suggests that program design may alter landlord and assisted-tenant incentives that shape decisions that affect energy consumption, including how to bill utilities. A program's structure may induce landlords to offer rental contracts that include or exclude utilities. Program incentives, billing arrangements, landlord investments, and assisted tenant preferences together determine consumption levels and future investment decisions. In this section, we first highlight key issues in determining billing arrangements in the unassisted rental market, then contrast this standard setting with the incentives for utility billing arrangements in assisted rental housing. We then look at consumption incentives when utilities are and are not included in rent under assisted housing programs.

Levinson and Niemann (2004) develop a model of energy use by unassisted tenants in the private rental market when landlords pay for utilities. Their model, outlined and extended in the following section, highlights the paradox of rental contracts that include utilities, which, in the basic model,

[7] 26 CFR § 1.42-10(b).

results in economic loss relative to contracts in which unassisted tenants pay utility bills separately. The model demonstrates that "landlord-side explanations" of metering costs, economies of scale, and asymmetric information about a building's energy efficiency can resolve this paradox. Using Residential Energy Consumption Survey (RECS) data and AHS data, the authors find evidence that these landlord-side explanations, rather than tenant preferences, drive billing arrangements.

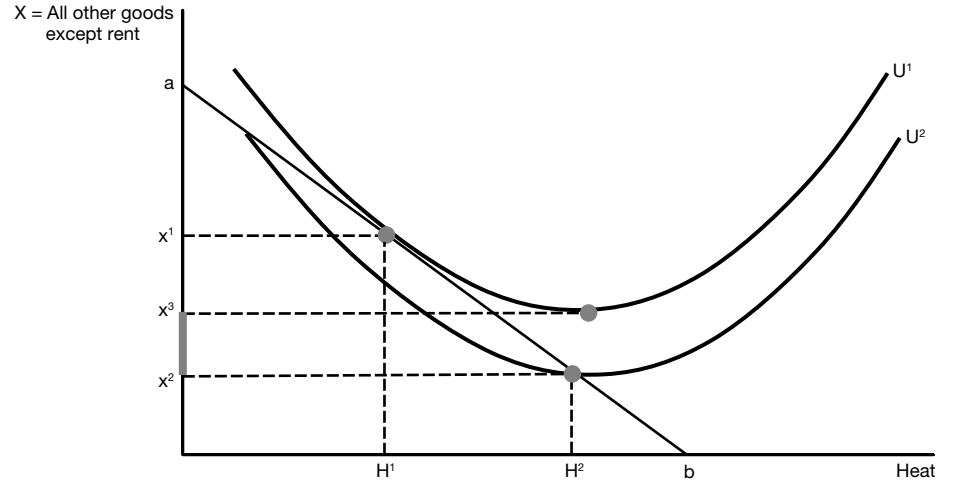
Research in the energy efficiency sphere has focused on principal-agent and split-incentive problems in landlord-tenant relationships (Davis, 2010; Gillingham, Newell, and Palmer, 2009). If unassisted tenants renting in the private market pay utility bills, landlord (agent) investments determine the level of energy efficiency in the unit, and the tenant (the principal) pays the associated costs. The unassisted tenant, in general, has incomplete information about the energy efficiency of the building; this lack of information makes it difficult for the landlord to pass on the full costs of economic welfare-improving energy efficiency investments. Accordingly, landlords are likely to underinvest in energy efficiency (Jaffe and Stavins, 1994; Maruejols and Young, 2010). In contrast, when owners pay the bill, unassisted tenants do not face the marginal cost of consumption and will consume more than the efficient amount of utilities. Levinson and Niemann's empirical analysis confirms that rents are higher in apartments with utilities included, but the increase does not cover the cost of the induced consumption. Munley, Taylor, and Formby (1990) also find evidence of additional usage.

We now adapt Levinson and Niemann's model to the case of affordable housing programs. Tenants have a dollars, which unassisted tenants divide between *Heat* and X (all other goods) after paying rent. X is a numeraire and the price of *Heat* is a/b. Tenant utility, U, has a satiation point—the ideal temperature when the price of consumption is zero. Exhibit 2, reproduced from Levinson and Niemann (which does not consider housing assistance), depicts optimal consumption in this model for unassisted tenants. When heat is not included in the rent, the unassisted tenant faces the marginal cost of consumption, utility is maximized at (H^1, X^1) with marginal tradeoffs equalized, and unassisted tenants spend $(a - X^1)$ on heat. When unassisted tenants do not face marginal costs, they consume to their satiation point. The model requires that landlords break even, so monthly rent increases to cover the increased consumption. This condition implies that the new consumption is on the old budget line, so when the landlord pays the bill, consumption is (X^2, H^2) with rent (now including heat) increasing by $(a - X^2)$. Using this model, the fact that we observe rental contracts in which landlords pay the utility bill is puzzling, because it results in lower unassisted tenant utility. As indicated previously, Levinson and Niemann and others explore resolutions to this question, including metering costs, economies of scale, and energy efficiency signaling.

As reviewed previously, public housing, the project-based Section 8 program, and voucher program target assisted tenants' housing and utility costs (simplified to heating for this discussion) as no more than 30 percent of income, whereas LIHTC properties fix assisted tenants' rents based on area incomes. Exhibit 3 depicts consumption decisions when the model is adapted to reflect the program design. First, consider the case in which the assisted tenant pays the heating bill. The assistance programs require the assisted tenant to pay the landlord rent—30 percent of income—less a "utility allowance" which, to avoid confusion with economic utility and to reflect Levinson and Niemann's exposition, we refer to as a "heating allowance," HA. In this scenario, the assisted tenant divides $0.7I + HA$ dollars (where I is income) between *Heat* and all other goods and maximizes utility by choosing (H^1, X^1). The assisted tenant spends $0.7I + HA - X^1$ on heat. If the housing authority has

Exhibit 2

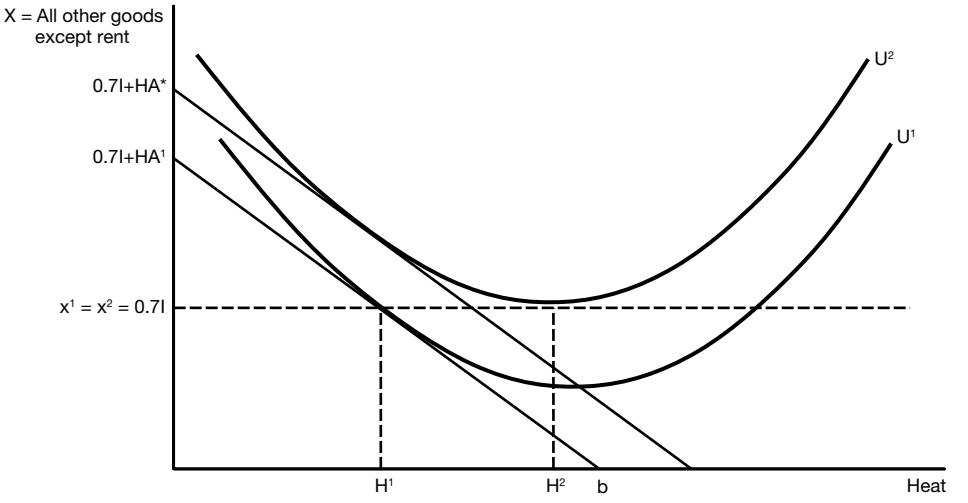
Optimal Consumption in Levinson and Niemann's Model for Unassisted Tenants



a = tenant after-rent income in dollars. b = tenant after-rent income in heat. U = tenant utility.
Source: Levinson and Niemann (2004)

Exhibit 3

Assisted Household Heat Consumption Decision



b = tenant after-rent income in heat. HA = heating allowance. U = tenant utility.

set the heating allowance to equal this amount of actual spending, then the assisted tenant indeed spends 30 percent of income on rent and heating costs, and $X^1 = 0.7I$. For any income range in which both *Heat* and *X* are normal goods, if the heating allowance is less than this amount, the assisted tenant will spend more than the heating allowance on heat. If the allowance is more than

this amount, the assisted tenant will spend less than the heating allowance. Notice that the difference in consumption between assisted tenants who pay for utilities separately and receive assistance and tenants who pay for utilities separately and do not receive assistance is driven entirely by the increase of after-rent disposable income provided by the housing assistance. To the extent that heat is a normal good, we expect this income effect to be positive, although the magnitude may be small.

When the landlord pays the heating bill, the assisted tenant pays the landlord 30 percent of income in rent, and the administering agency reimburses the landlord based on historical (or geographical) utility costs. As in Levinson and Niemann's market setting, assisted tenant heat consumption increases to the satiation point. Unlike in the market context, rents (and government reimbursements) are not sensitive to the amount of heat consumed. The assisted tenant consumes $X^2 = 0.7I$ of X and H^2 of *Heat*, which is preferable to consumption when assisted tenants face heating bills and a calibrated heating allowance. Of course, the assisted tenant would prefer to receive the cost that the housing authority is incurring to heat the apartment to H^2, but would spend only a fraction of that amount on heating. A heating allowance, *HA**, exists which would make the assisted tenant indifferent between the optimal consumption when paying the heating bill and satiated heating with a total rent of 0.3I. If the housing authority's heating allowance is less than *HA**, the assisted tenant is made worse off by paying the heating bill and $0.3I - HA$ in rent compared with having the landlord pay the heating bill and the tenant paying $0.3I$ in rent. If the heating allowance is greater than *HA** in this case, then the tenant is made better off. To the extent that allowances to assisted tenants paying utilities separately are calibrated to actual spending, our model predicts that assisted tenants would prefer that the landlord pay the utilities.

To summarize, because rents in housing assistance programs are set proportionally to tenants' income, when those rents include utilities, an assisted tenant's after-rent budget does not adjust with average utility costs, as would be expected in unassisted housing. This decoupling leaves assisted tenants better off when utilities are included in the rent set at 30 percent of income than with an allowance targeted so that observed rent plus utility spending equals 30 percent of income.

We now turn to landlord incentives based on our description of the assistance programs. Let *FMR* be the rental rate agreed between the landlord and the administering agency for a given subsidized apartment. When the landlord pays the heating bill, the housing authority pays the landlord the difference between the *FMR* and 30 percent of the assisted tenant's income, plus a heating allowance. The assisted tenant pays 30 percent of his or her income to the landlord, but we assume there is a risk that the assisted tenant will not make the payment. The landlord incurs known administration and maintenance costs (which could be allowed to depend on the billing arrangement) plus a heating bill. The amount of the heating bill is uncertain, because it depends on use and on the potentially changing price of heat. When the landlord pays the heating bill, the landlord's per-assisted-tenant profits are

$$Profit_{\text{llpays}} = (FMR - 0.3I) + E(0.3I) - Admin - E(HeatingBill_{\text{ll}}) + HA_{\text{ll}}. \quad (1)$$

Anecdotal evidence suggests that, although HUD often adjusts landlord utility allowances upward after years when utility costs are high, the allowances are not adjusted downward when costs are low. Under this scenario, HA_{ll} will be above the expected heating bill, and, when it is not, landlords are likely to recoup losses in future years. The difference is potentially profitable. In addition,

landlord administration costs may be lower when paying the bills because, when assisted tenants pay, landlords may have to collect bills from assisted tenants for the administering agency's use in determining tenant *HA*.

When assisted tenants pay the heating bill, the amount they pay the landlord decreases by the assisted tenant heating allowance HA_{ten}, and the amount the housing authority pays the landlord increases by this amount. The overall administrative and maintenance costs are still *Admin*. The landlord's per-assisted-tenant profits when the assisted tenant pays the heating bill are

$$Profit_{tenpays} = (FMR - (0.3I - HA_{ten})) + E(0.3I - HA_{ten}) - Admin. \quad (2)$$

When the assisted tenant pays the utilities separately, the landlord receives a greater proportion of the *FMR* from the housing authority, which is assumed to pay with certainty, whereas the assisted tenant may miss rent payments. This factor would lead the landlord to prefer that assisted tenants pay the bills.

If assisted tenants never miss rental payments and administration costs are the same under both regimes, the housing authority sets $HA_{landlord} = E(HeatingBill_{landlord})$, and the landlord's profit is the same under both scenarios. Thus, the landlord is indifferent between the two utility billing arrangements. Our understanding of program implementation suggests that, in the place-based programs (public housing, project-based Section 8, and LIHTC), administration costs are lower when landlords pay the bills, and heating allowances for a particular building are more likely to increase than to decrease. We would expect landlords in these programs to prefer to include utilities in the rent more often than their private market counterparts. In contrast, landlords of voucher holders may be less familiar with housing assistance reimbursement rules or face different cost structures because, at any given point, they may or may not have tenants receiving assistance. As such, these landlords are less likely to benefit from economies of scale in interacting with program rules and may be less likely to deviate from market practices in determining utility billing arrangements. We also note that neither scenario encourages landlords to make energy efficiency investments.

HUD has several policy goals for low-income housing programs. The primary goal is to provide low-income households with quality affordable housing, including adequate consumption of energy and other housing utilities. Adequate heat and electricity consumption is more likely when utilities are included in rent, rather than as a separate component of low-income household budgeting. HUD also gives priority to the continued participation of private owners in affordability programs, often referred to as the "preservation of affordable housing." Exposure to energy cost uncertainty without the possibility of recouping costs from assisted tenants may discourage participation, a concern that is mitigated if HUD reliably reimburses utility expenses. The agency's budget, which encourages program cost minimization, constrains these goals. Passing utility costs in affordable housing programs on to assisted tenants may lower HUD's costs, but it may also interfere with the primary goal of quality housing and utility provision. Increasing landlords' exposure to utility costs may also reduce HUD's budget, but, if landlords' profitability declines, HUD's preservation priorities may suffer. Although HUD does have an incentive to promote energy efficiency initiatives in new properties and in rehabilitating existing properties, to the extent that such initiatives lower HUD's costs, HUD must confront the tension between its policy goals and the potentially adverse effects that encouraging efficiency gains may have on landlords' and assisted tenants' financial incentives.

In summary, market forces require private market rents to respond to the increased average costs associated with including utility payments in rental contracts. At the same time, these contracts lead tenants to consume beyond the point at which the marginal benefit equals the marginal costs. Together, these conditions make the existence of these contracts an economic puzzle. In contrast, federal housing policy is not constrained by the market, but rather is focused on limiting housing and utility costs for as many assisted tenants as program budgets allow. Under our simplified exposition of current policy, assisted tenants will prefer rental contracts in which landlords pay utility costs, unless the utility allowance provided to assisted tenants is sufficiently greater than the amount they would spend on utilities when facing marginal costs. In practice, landlords are more likely to prefer paying utility bills because reimbursements are more often adjusted upward than downward, and because assisted-tenant pay regimes may result in higher administration costs. Finally, housing policy goals face a tension between providing sufficient utility consumption and containing costs. A system in which HUD reimburses landlords' utility costs achieves the goals of sufficient utility consumption and encourages program participation, but it does not provide direct financial incentives for energy efficiency or conservation.

Empirical Analysis

Our empirical analysis first compares the proportion of low-income renters who pay utility bills separately for assisted and unassisted tenants.[8] In making the comparison, we control for other factors that might influence landlords to offer, and tenants to prefer, rental contracts including or excluding utility costs. Most of these factors relate to both landlords' costs and tenants' preferences. They include the fuel source for heat, hot water, cooking, and other appliances; the existence of relevant major appliances, such as a dishwasher and clothes washer and dryer; the unit's physical characteristics that correlate to its energy efficiency or indicate quality, such as unit size, number of rooms, presence of a garbage disposal and trash compactor; if the unit is subject to rent control; the building's characteristics, such as age, number of units and floors, and whether the owner lives on site; and household demographics, including size, income, race and ethnicity, and educational attainment. Most of the unit and building characteristics represent significant capital investment decisions by landlords. Household location decisions involve myriad inseparable goods; we intend our large set of controls to control directly and indirectly for household preferences. Housing policy targets housing quality and adequacy, along with broader social objectives that are also related to our controls. In this article we do not explicitly model how either investment decisions or housing choices respond to the design of subsidized housing programs or how program design is determined or responds to the market. Rather, our regression estimates provide a reduced-form description of the observed outcomes that result from these varied and interconnected processes. We present the mean difference in the proportion of households that pay utility bills separately from the rent by government housing assistance status and estimate the regression-adjusted difference in this proportion, controlling for unit, building, and household observables.

[8] We now use "assisted tenants" and "unassisted tenants" to refer to AHS respondents who report receiving and not receiving housing assistance, respectively, as described subsequently.

We also compare utility expenditures for those low-income renters who pay utility bills separately from rent for both assisted and unassisted tenants. Because our data do not include consumption amounts, we focus on reported utility expenditure as a proxy for utility use. As with the determination of the inclusion of utilities with rent, a variety of landlord, household, and policy factors contribute to the amount of a utility used by a household, which, in turn, determines expenditure.[9] We again examine the regression-adjusted differences, controlling for observable differences in units, buildings, and households.

Our data source is the combined AHS national files from 2003, 2005, 2007, and 2009. The primary unit of observation in the survey is the housing unit, which is followed over time. The detailed housing unit information includes the building and occupant characteristics described previously. The survey also reports if households receive government rental assistance and the local income limits that housing authorities use to determine eligibility for assistance. These reports enable us to compare renters who receive low-income housing assistance to similarly low-income households that do not receive assistance.[10] Households report whether they pay utilities separately from, or included in, the monthly rent and, when paid separately, the monthly household expenditures on each utility type. The AHS is unique in providing housing assistance and eligibility information together with utility billing arrangement and expenditure. This information is the basis of our analysis for a significant sample of households drawn from across the country every 2 years.[11] We focus on the two primary energy utilities commonly observed for nearly all households in the AHS: electricity and gas. To construct our sample, we group the 2003, 2005, 2007, and 2009 AHS national sample microdata—the years for which area income limits are available. Our analysis is uniformly robust to narrowing the data set to any given year.

The AHS asks respondents if "the Federal, State, or local government pay(s) some of the cost of the unit," if "the building (is) owned by a public housing authority," and whether a government agency gave them "a certificate or voucher to help pay the rent for this housing unit." We code our government housing assistance variable, *GovAssist*, as a 1 for an affirmative response to any of these three questions and as 0 for a negative response to all. We also examine differences among these assisted tenants by creating three mutually exclusive categories. Our variable *Public* indicates an affirmative response to whether the building is owned by a housing authority, *Voucher* indicates an affirmative response to whether a certificate or voucher was received, and *Other Assist* indicates a positive response to government assistance receipt but a negative response to the other assistance questions. Error in the response to these questions is well documented. The appendix of Shroder (2002) is particularly helpful in assessing the nature of the error. Citing Casey (1992), Shroder reports that, although 91 percent of respondents who actually live in public housing correctly report living in a building owned by a PHA, 33 percent of voucher recipients, 42 percent of project-based

[9] We note that consumer utility pricing schedules are typically nonlinear, motivated in part as an additional policy assistance to low-income consumers. See Ito (2010) for a careful examination of how nonlinear pricing influences consumption.

[10] Because housing assistance is not considered an entitlement, most qualifying households do not receive benefits.

[11] Although the RECS provides higher fidelity reports of household energy consumption and the associated built environment, the small number of housing assistance recipients in the sample preclude using the survey for this overview. We hope to use the AHS and RECS surveys together in extensions of this article.

residents, and 10 percent of eligible unassisted residents incorrectly report living in public housing. Respondents do a somewhat better job identifying whether they receive any assistance; 81 percent of eligible nonrecipients correctly answered that they received no assistance and 3 percent, 17 percent, and 13 percent of public housing, voucher, and project-based recipients, respectively, incorrectly reported no assistance. Because of these reporting errors, our comparisons based on self-reported housing assistance status will likely understate actual differences between households that do and do not receive assistance. In our comparisons among different assistance recipient subgroups, our public housing group will also include households that actuality live in project-based assisted units and voucher recipients, our voucher group will also include households that actually live in project-based units, and our other assistance group will contain both voucher and project-based recipients. We rely on the AHS area average of the HUD very low-income limit, based on 50 percent of AMI, to create a comparison group of low-income unassisted tenants (which we define as households reporting income at less than 80 percent of local median income [LMI]). We designate households with reported incomes at or below the AHS very low-income limit variable, but who report no housing assistance, as our final group, *Qualify*.

Because our research questions deal with renters, we exclude owner-occupants in the AHS from our analysis. For each utility, the survey reports whether the household pays for the use separately or if it is included in the rent. We denote these variables as *PayElectric* and *PayGas*, each equal to 1 if the household pays the utility bill separately and 0 otherwise. Exhibit 4 reports means of these variables, along with a number of control variables for all renters, very low-income unassisted tenants, and assisted tenants, the latter both together and separated by public housing, voucher, and other assistance types. In spite of the documented misreporting of assistance type, large differences exist between group means for all our variables. Whereas 92 and 48 percent, respectively, of all unassisted tenants pay electricity and gas bills separately from rent, only 77 and 37 percent, respectively, of assisted tenants pay these bills separately. Means for voucher-assisted tenants are similar to the very low-income comparison group averages, except that voucher holders have larger households, slightly more income, and larger apartments. This result differs from that for tenants reporting other housing assistance types, whose average characteristics for all variables differ from those of both all unassisted tenants and the very low-income comparison group. Because households

Exhibit 4

Means of Selected Variables

	All Unassisted Renters	Qualify	GovAssist	Public	Voucher	OtherAssist
PayElectric	0.917	0.892*	0.771*‡	0.654*‡†	0.897*†	0.802*‡†
PayGas	0.483	0.473*	0.372*‡	0.324*‡†	0.487†	0.320*‡†
UnitSqFt	1,191	1,097*	1,045*‡	1,019*‡	1,114*†	1,010*‡
Rooms	4.48	4.27*	4.18*‡	4.03*‡†	4.53‡†	4.03*‡†
Persons	2.38	2.40	2.33*‡	2.21*‡†	2.64*‡†	2.16*‡†
Income (1k)	43.13	14.99*	16.52*‡	15.43*‡†	16.81*‡†	17.69*‡
BldgUnits	17.03	16.60	32.18*‡	39.4*‡†	17.58†	37.25*‡†
Dishwasher	0.511	0.392*	0.257*‡	0.118*‡†	0.378*†	0.323*‡†
N	32,601	12,565	4,118	1,654	1,242	1,222

*Note: Based on a two-sample t-test, this group mean is statistically different from the mean of *all other renters not receiving assistance, ‡all other very low-income renters, and †all other assisted households.*

receiving assistance differ from other low-income households and other renters in their number of people, unit size and age, and most other observable characteristics, the observed differences in incidence of utility billing arrangements or expenditures is not informative regarding the potential effect housing assistance has on these outcomes. The detail on these characteristics in the AHS enables us to control for these factors and present means of billing arrangement and expenditure as conditional on available household, unit, and building characteristics.

We turn to a multivariate regression to assess the extent to which the lower incidence of direct payment by assisted tenants derives from the policy design rather than from differences in observable building and household characteristics. We regress the binary variables *PayElectric* and *PayGas* in turn on housing assistance and low-income group indicators while controlling for four types of variables. The first type are the source-of-fuel and appliance variables, which indicate whether the utility is used for heat, hot water, cooking, air conditioning, and drying and whether the unit includes a clothes washer and dishwasher. The second variable type is characteristics of the unit and building: the log of the square footage, indicator variables for the number of rooms and bathrooms, indicator variables for the decade (a pre-1920 group and decade groups from the 1920s through 1960s) or 5-year span (from 1970–1974 to 2005–2009) in which the building was built, the number of units, number of units squared, an indicator for being taller than three floors, whether the unit is a condominium, whether the unit is rent controlled, whether the owner lives on site, and whether the unit has a garbage disposal and trash compactor. The third type includes occupant characteristics: the number of people in the household, the log of household income, race and ethnicity, and educational attainment. Finally, the fourth type includes whether the unit is in a rural or urban area, fixed effects for metropolitan areas when identifiable in the AHS, and census region by urban status groupings when the metropolitan area is not available. This set of geographic controls should capture the combined contributions of weather, local utility infrastructure and policy, and other local factors.

Our regression results, presented in exhibit 5, indicate that, although some of the difference between assisted and unassisted households in the frequency of utility billing separate from rent is explained by other factors, an economically and statistically significant correlation between assistance and utility billing structure remains. Whereas the differences in unconditional means between assisted tenants who report living in public housing and unassisted tenants are 26.3 and 11.1 percentage points for *PayElectric* and *PayGas* respectively, the conditional difference is estimated to be 20.6 and 9.7 percentage points, respectively.[12] The measured gap for households in the *OtherAssist* category also decreases but remains substantive, at 7.4 and 5.4 percentage points, respectively, for *PayElectric* and *PayGas*. In contrast, differences in the rate at which voucher-assisted tenants pay for electricity separately remain indistinguishable from very low-income unassisted tenants, with a marginally significant lower rate for voucher-assisted tenants compared with unassisted renters not in the low-income comparison group. For *PayGas*, households receiving vouchers are again slightly less likely to pay separately from rent, with a 3.4-percentage-point conditional difference compared with unassisted households. In all cases, coefficients do not change materially when the sample is limited to renters with incomes below 80 percent of LMI.

[12] In each case, an F-test rejects that the coefficient is equal to the difference in the unconditional means.

Exhibit 5

Key Coefficients for Pay Utilities Separately Regressions

	PayElectric			PayGas		
	All Renters	All Renters	< 80% LMI Renters	All Renters	All Renters	< 80% LMI Renters
GovAssist	– 0.107***			– 0.064***		
	(0.018)			(0.014)		
Public		– 0.206***	– 0.198***		– 0.097***	– 0.101***
		(0.030)	(0.029)		(0.027)	(0.027)
Voucher		– 0.020*	– 0.014		– 0.034**	– 0.041**
		(0.012)	(0.013)		(0.015)	(0.016)
OtherAssist		– 0.074***	– 0.054***		– 0.054***	– 0.051***
		(0.018)	(0.016)		(0.014)	(0.016)
Qualify	– 0.014**	– 0.015**	– 0.010*	– 0.009	– 0.009	– 0.010
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)
N	35,724	35,724	23,192	35,724	35,724	23,192
R^2	0.103	0.111	0.125	0.454	0.454	0.447

LMI = local median income.

** Coefficients are statistically significantly different from zero at the 10% level. ** Coefficients are statistically significantly different from zero at the 5% level. *** Coefficients are statistically significantly different from zero at the 1% level.*
Notes: All regressions also include fuel and appliance, unit and building characteristics, household characteristics, and geographic control variables. All coefficient estimates are available from the authors. Robust standard errors reported in parentheses. "All Renters" indicates the sample used to estimate the two different models in the first two columns.

The smaller coefficients for the *Voucher* group, which are statistically different from the coefficients for the *OtherAssist* group, are consistent with the observed differences, because they are a landlord response to housing policy design. Voucher holders' landlords are less likely to have made investments that reflect the incentives embedded in the policy design compared with both PHA property managers and landlords who develop a property with the intention of serving assisted tenants.

Our first empirical results demonstrate that the lower frequency with which assisted tenants pay utility bills separately from rent is robust to including controls for observable building and household characteristics and for unobservable city characteristics. Because we control for differences in building and household characteristics and, in addition, limit our sample to a low-income, unassisted tenant comparison group, these regressions suggest that less frequent separate utility payment by assisted tenants is an outcome of housing assistance policy.

Although differences in the frequency of separate payment are robust to a full set of controls, differences in the amount paid in monthly utility bills are not. As reported in exhibit 6, among those billed for utilities, assisted tenants' average monthly bills are not statistically different from the $77 and $61 a month mean for electricity and gas, respectively, that unassisted tenants pay. Assisted tenants reporting residence in public housing, however, pay statistically significantly lower monthly bills for electricity ($69 a month) and voucher recipients pay a higher amount ($87 a month). Similar discrepancies exist for gas, with billed public housing and voucher expenses of $58 and $70, respectively.

These differences are not robust to the inclusion of unit, building, and household controls. We use the same variables as controls as in our previous regressions, except that we now fit geographic

Exhibit 6

Means of Selected Variables by Electricity and Gas Paid Separately

	All Renters		Qualify		GovAssist		Public		Voucher	
	PayElectric = 0	PayElectric = 1	PayElectric = 0	PayElectric =1	PayElectric = 0	PayElectric = 1	PayElectric = 0	PayElectric = 1	PayElectric = 0	PayElectric = 1
MonthlyBill		77.7		74.5*		76.1		68.8*†‡		86.9*†‡
UnitSqFt	1,076	1,202$^{\Delta}$	1,104	1,042	926	1,080$^{\Delta}$	973	1,043	831	1,146$^{\Delta}$
Rooms	3.84	4.54$^{\Delta}$	3.69	4.34$^{\Delta}$	3.65	4.33$^{\Delta}$	3.65	4.22$^{\Delta}$	3.77	4.61$^{\Delta}$
Persons	1.97	2.41$^{\Delta}$	1.95	2.44$^{\Delta}$	1.89	2.45$^{\Delta}$	1.89	2.38$^{\Delta}$	2.04	2.71$^{\Delta}$
Income (1k)	3.57	4.37$^{\Delta}$	1.31	1.52$^{\Delta}$	1.64	1.65	1.47	1.58	2.10	1.63
BldgUnits	37.31	15.18$^{\Delta}$	34.84	14.39$^{\Delta}$	67.84	21.59$^{\Delta}$	69.61	23.39$^{\Delta}$	39.21	15.08$^{\Delta}$
Dishwasher	0.36	0.53	0.28	0.41	0.14	0.29	0.08	0.14	0.21	0.40
N	2,715	29,886	1,355	11,210	943	3,175	573	1,081	128	1,114

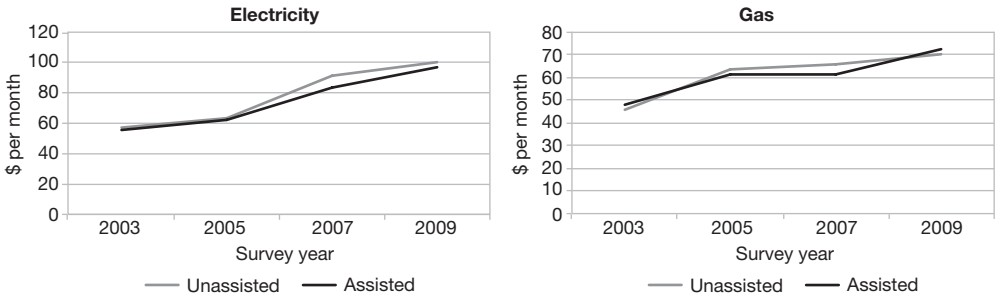
	All Renters		Qualify		GovAssist		Public		Voucher	
	PayGas = 0	PayGas = 1	PayGas = 0	PayGas =1	PayGas = 0	PayGas = 1	PayGas = 0	PayGas = 1	PayGas = 0	PayGas = 1
MonthlyBill		61.07	61.77	61.39	57.51	69.63				
UnitSqFt	1,076	1,202$^{\Delta}$	1,012	1,193$^{\Delta}$	944	1,215$^{\Delta}$	942	1,180$^{\Delta}$	1,001	1,232$^{\Delta}$
Rooms	3.85	4.54$^{\Delta}$	3.99	4.57$^{\Delta}$	3.92	4.62$^{\Delta}$	3.80	4.52$^{\Delta}$	4.20	4.87$^{\Delta}$
Persons	1.97	2.42$^{\Delta}$	2.14	2.68$^{\Delta}$	2.06	2.78$^{\Delta}$	1.97	2.72$^{\Delta}$	2.35	2.95$^{\Delta}$
Income (1k)	3.57	4.38$^{\Delta}$	1.42	1.59$^{\Delta}$	1.57	1.79$^{\Delta}$	1.50	1.63	1.58	1.79
BldgUnits	37.31	15.18$^{\Delta}$	23.15	9.29$^{\Delta}$	42.97	13.96$^{\Delta}$	52.78	11.50$^{\Delta}$	25.10	9.64$^{\Delta}$
Dishwasher	0.36	0.53$^{\Delta}$	0.46	0.31$^{\Delta}$	0.26	0.26	0.11	0.13	0.41	0.34$^{\Delta}$
N	29,886	2,715	6,622	5,943	2,586	1,532	1,118	536	637	605

*Note: Based on a two-sample t-test, this group mean is statistically different from the mean of * all other renters not receiving assistance, ‡ all other very low-income renters, † all other assisted households, and $^{\Delta}$ households in the same group with either PayElectric=0 or PayGas=0.*

time trends in rates. The relatively dramatic increase in utility bills over the survey years, shown in exhibit 7, motivated this decision. We present coefficients from the regressions of reported monthly electricity and gas bills on housing assistance group indicators and on our control variables in exhibit 8. With the possible exception of a slight increase in electricity expenditure among voucher recipients, differences in monthly gas and electricity bills for assisted and unassisted tenants are

Exhibit 7

Average Monthly Utility Bills of Renters by Government Assistance



Source: Based on author's tabulations of American Housing Survey data

Exhibit 8

Key Coefficients for Amount Paid in Utilities Regressions

	Electric				Gas			
	All Renters	All Renters	Renters and Owners	< 80% LMI Renters	All Renters	All Renters	Renters and Owners	< 80% LMI Renters
GovAssist	– 0.005 (0.013)				– 0.018 (0.022)			
Public		– 0.031 (0.021)	0.006 (0.021)	– 0.030 (0.023)		– 0.045 (0.035)	– 0.044 (0.036)	– 0.070 (0.037)
Voucher		0.028 (0.017)	0.068*** (0.017)	0.033* (0.018)		0.003 (0.027)	0.027 (0.026)	0.009 (0.029)
OtherAssist		– 0.014 (0.020)	0.030 (0.020)	– 0.006 (0.020)		– 0.015 (0.033)	0.004 (0.038)	– 0.011 (0.040)
Qualify	– 0.010 (0.008)	– 0.010 (0.009)	0.011** (0.005)	– 0.006 (0.008)	– 0.004 (0.014)	0.004 (0.014)	0.003 (0.008)	– 0.001 (0.014)
Renter			– 0.010** (0.005)				– 0.034*** (0.010)	
N	32,227	32,227	130,893	20,510	16,480	16,480	32,222	23,192
R^2	0.318	0.318	0.301	0.323	0.242	0.242	0.211	0.447

LMI = local median income.

** Coefficients are statistically significantly different from zero at the 10% level. ** Coefficients are statistically significantly different from zero at the 5% level. *** Coefficients are statistically significantly different from zero at the 1% level.*

Notes: All regressions also include fuel and appliance, unit and building characteristics, household characteristics, and geographic time trend control variables. All coefficient estimates are available from the authors. Robust standard errors reported in parenthesis. "All Renters" indicates the sample used to estimate the two different models in the first two columns.

captured by the other characteristics determining expenditure. We conclude that the small increase in disposable income relative to other low-income households in similar housing increases utility expenditures.

Our empirical approach captures the reduced-form confluence of landlord business decisions, tenant housing and energy demand, and government policy. Although we do not estimate parameters governing these processes, we have identified a few stylized facts of utilities and subsidized housing in the AHS. First, observed lower instances of gas and electricity being billed directly to assisted tenants are robust to controlling for factors governing landlords' and tenants' decisions. This observation is consistent with incentives for landlords and assisted tenants embedded in housing policy design and the possible policy implication of increased utility costs. Among households paying separate utility bills, however, spending differentials between those in public housing, voucher recipients, and unassisted tenants are not attributable to government programs.

Conclusion

Government subsidy program regulations can affect utility billing arrangements and expenditures. In this article, we argue that the programs' treatment of utility expenditures creates incentives for both landlords and assisted tenants to prefer including utilities in rent and does not motivate conservation or energy efficiency investments. This condition exists because, among the four primary federal assisted housing programs, utility allowances are generally lagged, partial, or one-way responses to changes in year-to-year costs. As a result, contract rents do not rise with average utility costs when utilities are included in the rent as they would in nonsubsidized competitive markets. Assisted tenants will prefer that landlords pay utility bills unless the utility allowance sufficiently exceeds actual spending, and landlords may increase profits if allowances adjust upward more easily than downward. We note that these incentives may be more muted in the LIHTC and voucher programs and suggest that future research using administrative data from all the programs could determine the extent to which they indeed differ.

Using self-reported AHS data, we confirm that tenants receiving some form of government subsidy are more likely to live in a property where the owner pays the utilities. Specifically, assisted tenants who live in public housing are 21 percentage points less likely to pay for their own electricity and 10 percentage points less likely to pay for gas than are low-income renters receiving no assistance. The differences are much less pronounced, however, for assisted tenants who report receiving vouchers, suggesting that landlords with voucher tenants act differently than landlords of the other assisted groups; differences in cost structures or familiarity with assistance program rules may contribute to these differences.

We also look at the differences in energy costs between assisted and unassisted low-income tenants who pay their utilities. Our results indicate no significant difference in utility costs between these groups. Observable differences exist in mean spending between assisted and unassisted households, but these differences are attributable to differences in characteristics of the units, buildings, and households rather than in government assistance.

Our theoretical and empirical analysis indicates that both landlords and assisted tenants may be influenced by program structures. We also find evidence that some program rules provide

little incentive for landlords or assisted tenants to contain costs. These issues are important to tackle because these program structures may undermine current and future energy efficiency initiatives. Our results suggest that the incentives for billing arrangements and subsequent energy expenditure embedded in assisted housing programs are relevant to HUD's increased emphasis on sustainability. Our analysis indicates that administration costs of both billing and utility allowance adjustments may play a role in determining billing arrangement, suggesting that administrative and technology improvements may promote more economically and environmentally efficient arrangements.

These results are a foundation for further analysis. Detailed building-level utility costs for properties in each of these portfolios would provide a clearer and likely more nuanced picture of the differences in energy use and costs across the assisted housing programs and across local program guideline implementations. Such an analysis will provide guidance into ways programs can incentivize landlords and assisted tenants to reduce utility costs, which will prove beneficial for cost containment in existing programs and the development of future initiatives.

Acknowledgments

The authors thank Evan Seiler for his assistance with the American Housing Survey data. They also thank Joshua Montesinos at the National Equity Fund and Doris Goodman and Eric Wolsky at the New York Office of the U.S. Department of Housing and Urban Development for their insight on these programs. Finally, they thank Richard Samson at Stewards of Affordable Housing for the Future and Vicki Been, Ingrid Gould Ellen, and staff at the Furman Center for Real Estate and Urban Policy for their feedback on this article.

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