Household Energy Bills and Subsidized Housing

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Abstract: Household energy consumption is critical to national energy policy. Federal housing assistance programs alter the incentives faced by landlords and tenants for utility bills to be included in rent or paid separately, and consumption incentives differ under each arrangement. This paper identifies and explores the rules for utilities and associated landlord and tenant incentives across the four major federal housing subsidy programs. Then, using data from the American Housing Survey, we examine the differences in utility billing arrangements between subsidized and unsubsidized low-income renters, controlling for a variety of other factors. Finally, looking at tenants who pay their bills directly, we explore the differences in utility expenditures between subsidized and unsubsidized households. Respondents who report receipt of government housing assistance also report paying utility bills separately from rent less often than do other low-income renters. When tenants pay rent and utility bills separately, observable differences in energy expenses of the two populations are driven by differences in unit, building, and household characteristics rather than receipt of government assistance.

Federal housing policy emphasizes both sustainability and affordability;[1] household energy use is central to both of these priorities. The federal government provides some form of subsidy for over 6 million units of affordable housing through four housing programs: Project-Based Section 8, Section 8 Vouchers, the Low Income Housing Tax Credit and public housing. This paper asks what incentives federal housing assistance programs create for whether tenants or landlords pay utility bills and for subsequent energy consumption, and whether billing arrangements and expenditures for gas and electricity reported in the American Housing Survey (AHS) reflect these incentives.

Some provisions of federal housing assistance programs would lead landlords and tenants to prefer that landlords pay utility costs, while other program design features work towards tenant payment. We provide an overview of utility costs in the major federal housing programs and argue that on balance and in practice the incentives for landlord payment are dominant and that this arrangement will be observed more frequently. The incentives for consumption under current policy design are less ambiguous. Under the major housing programs, landlords have little incentive to contain costs or improve energy efficiency under either billing arrangement. When utilities are included in the rent, assisted-housing tenants have no financial incentives to conserve; when they pay for usage, assisted tenants face the marginal costs of their consumption just as do households not receiving assistance. We note that in this paper we do not observe consumption empirically but we are able to examine reported expenditures for households paying electricity separately from rent.

Using data from the American Housing Survey (AHS), we show that, consistent with the incentives we identify in federal low-income housing programs, respondents who report receipt of government housing assistance also report paying utility bills separately from rent less often than do other low-income renters. This difference is robust to controlling for observable differences in the characteristics of the buildings of residence and the respondents. For example, we find that the share of households for whom the utility is included in the rent is 21 percentage points lower for electricity and 10 percentage points lower for gas among households who report

[1]HUD Press Release June 21st, 2010:
http://portal.hud.gov/portal/page/portal/HUD/press/press_releases_media_advisories/2010/HUDNo.10-131.
USEPA Press Release June 16th, 2009:
http://yosemite.epa.gov/opa/admpress.nsf/0/F500561FBB8D5A08852575D700501350.http://portal.hud.gov/portal/page/portal/HUD/press/press_releases_media_advisories/2010/HUDNo.10-131http://yosemite.epa.gov/opa/admpress.nsf/0/F500561FBB8D5A08852575D700501350.

living in a building owned by a public housing authority relative to renters receiving no assistance. Tenants who report a subsidy in the form of a voucher are also less likely to pay utilities, though they do so at a higher rate than those reporting other forms of household assistance. Because landlords of voucher holders are less likely to make decisions based on housing policy, this variation by *type* of housing assistance is consistent with the idea that some of the differential in billing arrangements between assisted and non-assisted households results from landlord responses to policy design. Additionally, our empirical findings for spending on utilities suggest no difference in energy consumption for households receiving housing assistance among renters paying bills separately. We find that observable differences in mean spending of assisted and not assisted households are attributable to differences in characteristics of the units, buildings, and households rather than government 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 affects those price incentives. The United States Department of Housing and Urban Development (HUD) administers federal affordable housing programs. HUD's housing policy prioritizes minimizing the environmental impacts of residential energy consumption, as exemplified by the agency's $100 million energy innovation fund, a key component of HUD's sustainability strategy. Additionally, household spending on utilities interacts closely with housing affordability as energy costs may represent a large share of low-income household budgets (HUD, 2000). Additionally, HUD's annual spending on public and subsidized housing includes $5 billion for energy (HUD, 2008), and energy efficiency and conservation gains may present a significant opportunity for savings or the redirection of resources in a time when the agency is facing significant cuts. [2]

Landlords and developers may influence energy consumption through business decisions including utility billing arrangements, maintenance, and building and appliance upgrades (Levinson and Niemann, 2004; Davis, 2010). Renters consider billing arrangement and expected utility costs, among other factors, when choosing an apartment. Subsequent energy consumption also responds to billing arrangement, utility and housing costs, characteristics of the residence,

[2] HUD Press Release February 14th 2011: " The Department's $47.8 billion in gross budget authority is offset by $6 billion in projected FHA and Ginnie Mae receipts credited to HUD's appropriations accounts, leaving net budget authority of $41.7 billion, or 2.8 percent below the fiscal year 2010 actual level of $42.9 billion," http://portal.hud.gov/hudportal/HUD?src=/press/press_releases_media_advisories/2011/HUDNo.11-016.

family circumstances such as size of the household, and income. Affordable housing programs treat utility expenses in a variety of ways that may alter tenant preferences for billing arrangements and incentives for energy consumption or conservation, and may affect how landlords structure billing arrangements or invest in conservation programs. This differential in incentives provides a unique opportunity to analyze the outcomes of HUD policy choices with regard to renter and landlord choices that determine energy use.

This paper provides an initial assessment of the effects of the treatment of utility costs in assisted housing programs. Our focus is on utility billing arrangements and monthly energy expenditures as reported in the AHS. Energy expenditures are only reported for households paying for utilities separately from rent, and the survey contains no information on energy use or landlord building investments. It is also limited by the accuracy of self-reported responses and detail on the particular assisted housing program covered. Our analysis benefits, however, from the survey's detailed information on housing units and households to begin answering these questions. The differences in billing arrangements and the equality in expenditures we document between otherwise similar subsidized and unsubsidized housing units recommends more in-depth investigations. Administrative data from housing assistance programs on household characteristics, energy use, and capital investments could be leveraged to consider how energy consumption, costs, and efficiency investments vary across program designs. This type of research will enable more precise policy recommendations. For example, while our results indicate that energy expenditure of assisted households who pay utility bills separately is comparable to that of similar low-income households, further data and research is needed to assess whether this consumption level meets policy goals, is more efficiently attained than when landlords pay utility costs, and does not have adverse consequences for efficiency investments.

I. Utility Costs and Affordable Housing Programs

Federal, state and city governments have created programs that promote or provide 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. In the wider literature, the impacts of housing assistance are well explored. For instance, Shroder (2002) reviews literature on whether

Table 1: Federal assisted rental housing programs

Program	Units (millions)	Administering Agency	Funding Agency
Tenant-Based Section 8	2.09	Contract Administrator or HUD Regional Office	HUD
LIHTC	1.70	State and/or Local Allocating Agency	Tax Expenditure
Project-Based Section 8	1.28	Contract Administrator or HUD Regional Office	HUD
Public Housing	1.13	Local Public Housing Authority	HUD

housing assistance hinders the self-sufficiency of assisted families. We examine the overlap of assisted housing and utility billing arrangement and expenditure, beginning by describing how the four major federal housing assistance programs treat utility expenses. Public housing, the Project-Based Section 8 Program, Tenant Based Section 8, and Low Income Housing Tax Credits together provide the bulk of government housing assistance in the U.S. Table 1 compares the programs which we will now briefly describe, along with their respective provisions for utility costs.

The federal government first began to fund the development of public housing with the passage of the 1937 Housing Act. Since then, there have been many changes to federal housing policy. These changes range from the entity that financed the housing -- the federal government versus state or local government -- to the size of the buildings. Public housing was originally composed of smaller walk-up apartments. In the 1950s, more and more high rise properties were developed (Stoloff, 2004). Since the late 1960s, federal policy has shifted away from public housing in favor of subsidies to privately-owned, income-restricted developments and voucher programs, and recent decades have seen few additions to the supply of public housing. As of 2009, there were approximately 1.13 million public housing units in the U.S. (HUD, 2009).

Local Public Housing Authorities (PHAs) own and manage public housing developments, collecting rents based on tenant incomes with additional costs covered by rent subsidies from the development's funding agency, which is usually HUD. In some developments, PHAs pay all utility costs. In the case where the PHA pays the utility costs, tenants are required to 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 cost of the prior three 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] Higher frequency variability in utility costs is absorbed elsewhere in PHA budgets.

In other public housing developments, tenants pay some or all of their utilities. Every year the local PHA develops a utility allowance based on local utility costs. Utility allowances are a flat amount. 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 a tenant pays utilities, his rent—originally, 30 percent of income—is decreased by the relevant utility allowance. If the tenant consumes less than the utility allowance, he is allowed to keep the difference. If a tenant's utility costs are higher than the utility allowance, he pays the difference. Under this system, tenants also face seasonal variation in utility costs. 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 (based on local income limits set by HUD—typically 80 percent of Area Median Income, or AMI). In return, HUD provides a rental subsidy. Tenants pay 30 percent of their income in rent, and HUD pays the difference between the tenant's payment and HUD's approved rent, which is benchmarked around local Fair Market Rent (FMR).[5] There were approximately 1.28 million units of Project-Based Section 8 housing across the country as of 2009 (HUD, 2009).

The Project-Based Section 8 Program treats utility costs similarly to public housing, with some key differences in implementation. In the case where the owner pays the utilities, tenants pay 30 percent of their income in rent, and the additional HUD subsidy includes the remaining differential and utility costs. An owner initially establishes utility costs based on like buildings,

[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] Many Project-Based Section 8 properties are operated by non-profits. In this case, rents are based on operating costs rather than FMR.

but is able to adjust that amount based on actual costs in subsequent years. If utility costs are higher than the last year, an owner can submit a rent adjustment based on the higher costs. The owner thus receives the same amount of payment from the tenant, 30 percent of their income, however, now receives a larger subsidy from HUD. While owners are expected to submit rent adjustments every year, in practice most owners ask for adjustments less frequently.[6] Profit motives suggest that owners are more likely to request adjustments only in years with high utility costs.

In the case where the tenant pays for the utilities in a Project-Based Section 8 property, the tenant payment is discounted by the utility allowance. Each month the tenant pays the owner 30 percent of their income minus the utility allowances, with the remaining rent subsidized by HUD. The tenant utility allowance is established based on an analysis of existing utility costs, adjusted for bedroom size.[7] This increase system relies on tenants providing landlords with utility bills so that a given year's average cost for the building can be verified. As in public housing, tenants face the marginal cost of their consumption in this scenario, including any seasonal fluctuations in utility bills.

HUD's Section 8 Voucher Program provides a subsidy to low income voucher recipients for any privately-owned rental unit with a rent at or below the "voucher rent," usually 110 percent of FMR, set by the local PHA.[8] Over 2 million U.S. households receive vouchers as of 2009 (HUD, 2009).

For the Section 8 voucher program, the local PHA establishes a utility allowance based on citywide averages and projected utility rate changes, again adjusted by bedroom size. If utilities are not included in the rent, the tenant pays the landlord 30 percent of his income minus the utility allowance, with HUD paying the remaining rent each month. If the owner pays for utilities, HUD's payment includes the utility allowance, and the tenant pays 30 percent of his income in rent. In principle, the amount HUD pays the landlord is the same in either scenario, with the tenant payment decreased by the utility allowances when utilities are paid separately. The local PHA will adjust rents and utility allowances based on the past year's market trends and

[6] Based on a conversation with Eric Wolsky and Doris Goodman from the HUD NYC Regional Office.
[7] 24 CFR § 880.610
[8] A tenant can chose to rent a unit above the allowable rent level, but is responsible for paying the difference between the allowable rent and actual rent. This is only true if 30 percent of the tenant's income plus that difference of the allowable rent and actual rent comes to less than 40 percent of the tenants income.

costs; however, it will adjust the utility allowance sooner if utilities increase more than 10 percent during the year (HUD, 2001).

The Low-Income Housing Tax Credit (LIHTC) program was created in 1986 and gives saleable tax credits to developers who build or rehabilitate affordable housing. In order for a project to qualify for LIHTCs, at least 20 percent of the project's units must be occupied by households whose incomes are 50 percent or less than the AMI, or 40 percent of the units must be occupied by households whose incomes are 60 percent or less of the AMI for the first 30 years of the building's operation. LIHTC buildings vary in size but tend to have billing arrangements that involve tenants paying for at least a portion of their utilities.[9] Nationally there are over 1.7 million LIHTC units.[10]

Rules for LIHTC properties differ from the other programs. Rents are capped by the State or local agency administering the credit at no higher than 30 percent of the monthly income of the group that property is targeting. A tenant's individual income determines eligibility for a unit, but not monthly rental payments. Since rents are established annually by the local administering agency, the only local variation in rents from one property to another is the utility allowance. The utility allowance can be set in one of three ways: an owner can use the utility allowance that is established by the local PHA, by the administering agency, or by a professional who analyzes costs for the prior year.[11] If the tenant pays his utilities, his rent is reduced by this utility allowance and he faces the actual billed costs of utility consumption. When the owner pays the utilities, he receives the normal LIHTC rent from the tenant, set to include the cost of utilities. In this scenario, fluctuations in utility costs translate to the landlord's bottom line.

II. Incentives for billing arrangement and utility consumption

Our review of the treatment of utility expenses in housing assistance programs suggests that program design shapes landlord and tenant incentives for how utilities are billed and, ultimately, how much energy is used. Program settings may induce landlords to offer rental contracts that include or exclude utilities. These decisions determine the billing arrangements available to tenants in assisted housing programs. Program incentives, billing arrangements,

[9] Based on a conversation with Joshua Montesinos of the National Equity Fund.
[10] *LIHTC Database Access*. Department of Housing and Urban Development. Web. 2011. <http://lihtc.huduser.org/>.
[11] 26 CFR § 1.42-10(b)

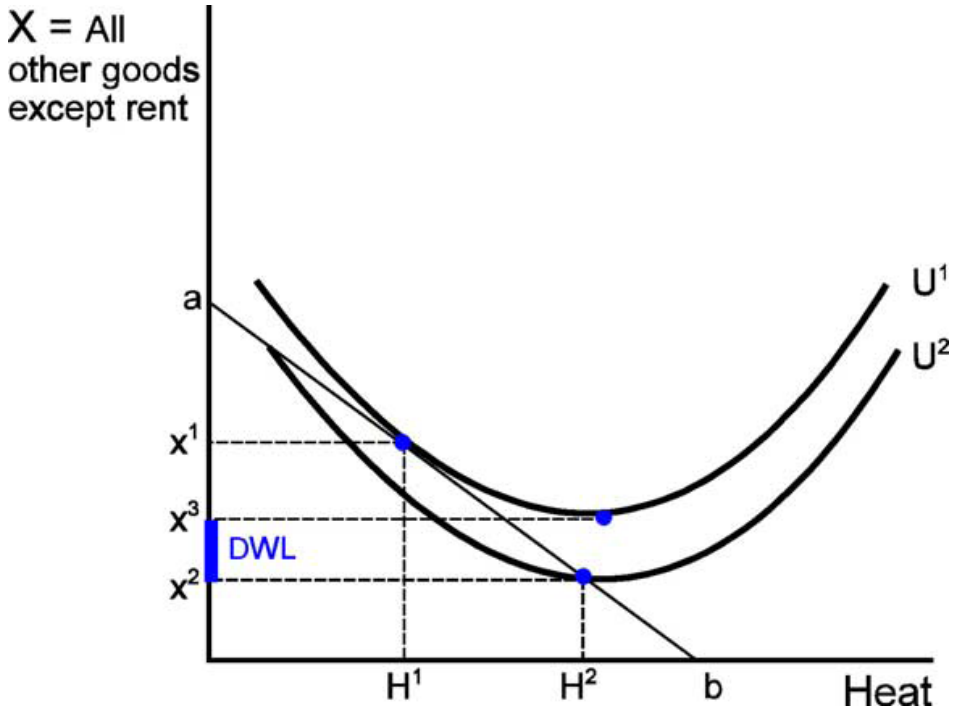
landlord investments, and tenant preferences together determine consumption levels and future investment decisions. Before describing the incentives for utility billing arrangement and consumption under assisted housing programs, we prepare a contrast by highlighting key issues in the determinant of billing arrangements in the non-subsidized rental market.

Levinson and Niemann (2004) develop a model of energy use by apartment tenants when landlords pay for utilities. Their model, outlined and extended below, highlights the paradox of rental contracts that include utilities, which in the basic model, result in economic loss relative to contracts where tenants pay utility bills separately. They demonstrate that metering costs, economies of scale, and billing arrangement as a signal of unobservable energy efficiency can resolve this paradox. Evidence for the landlord-side explanations is found using Residential Energy Consumption Survey (RECS) data together with AHS data.

In the energy efficiency sphere, research has focused on principal-agent and split-incentive problems in the landlord-tenant relationships (Gillingham et al., 2009; Davis, 2010). If tenants pay utility bills, landlord (i.e. the agent) investments determine the level of energy efficiency in the unit while the tenant (i.e. the principal) pays the associated costs. The tenant generally has incomplete information about the energy efficiency of the building, while the landlord will find it difficult to pass on the full cost of energy efficiency in the rental price. Accordingly, they are likely to underinvest in energy efficiency (Jaffe and Stavins, 1994; Maruejols and Young, 2010). In contrast, when owners pay the bill, 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. Evidence of additional usage is also found by Munley et al (1990).

We now adapt Levinson and Niemann's model to the case of affordable housing programs. Tenants have *a* dollars to 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. Figure 1 from Levinson and Niemann depicts optimal consumption in this model. When tenants face marginal costs, utility is maximized at (H^1, X^1) with marginal tradeoffs equalized, and spend (a - X^1) on heat. When 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 implies

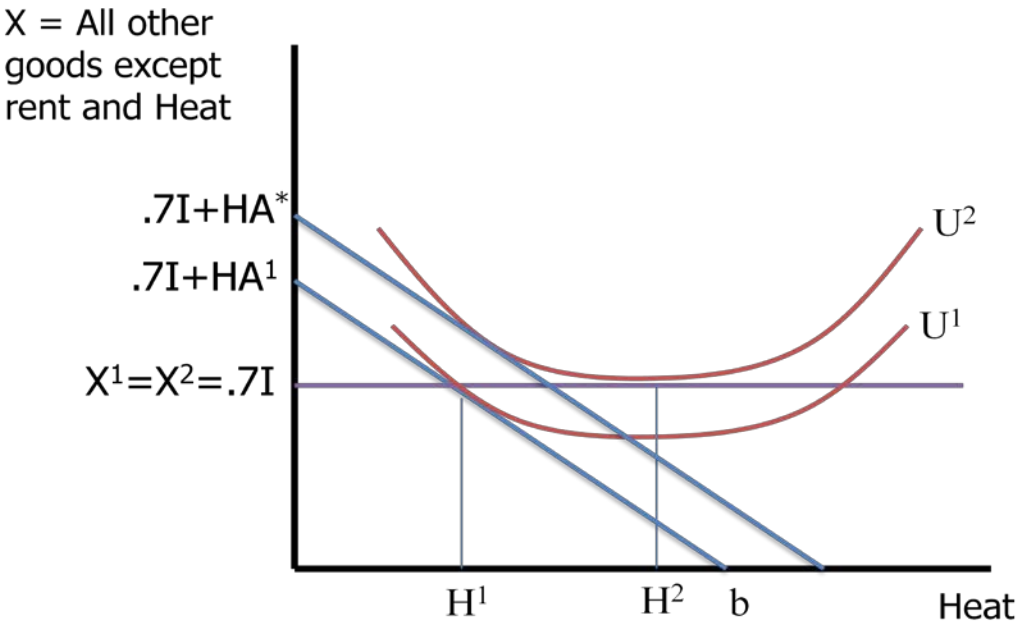
1: Figure 1 from Levinson and Niemann 2004



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 where landlords pay the utility bill is puzzling because it results in lower tenant utility. As indicated above, Levinson and Niemann and others explore resolutions to this question, including metering costs, economies of scale, and energy efficiency signaling.

As reviewed above, public housing, the Project-Based Section 8 Program, and the Section 8 Voucher Program target tenant housing and utility costs (simplified to heating for this discussion) to be no more than 70 percent of income, while LIHTC properties fix tenant rents based on area incomes. Figure 2 depicts consumption decisions when the model is adapted to reflect the program design. First consider the case in which the tenant pays the heating bill. The assistance programs require the tenant to pay the landlord rent of 30 percent of income less a "utility allowance" which, to avoid confusion with economic utility, we refer to as a "heating allowance," *HA*. In this scenario, the tenant divides .7*I*+*HA* dollars (where *I* is income) between Heat and all other goods, and maximizes utility by choosing (H^1,X^1). The tenant spends .7*I*+*HA* - X^1 on heat. If the housing authority has set the heating allowance to equal this amount of actual

2: Assisted household heat consumption decision



spending, then the tenant indeed spends 30 percent of income on rent and heating costs and X^1=.7I. For any range of income where both Heat and X are normal goods, if the heating allowance is below this amount, the tenant will spend more than the heating allowance on heat. If the allowance is above this amount, the tenant will spend less than the heating allowance target. Notice that the differences in consumption between 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 tenant pays the landlord rent of 30 percent of income and the administering agency reimburses the landlord based on historical (or geographical) utility costs. Similar to Levinson and Niemann's market setting, 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 tenant consumes X^2=.7I of X and H^2 of heat, which is preferable to consumption when tenants face heating bills and a calibrated heating allowance. Of course, the tenant would prefer to receive the cost that the

housing authority is incurring to heat the apartment to H^2, but would only spend a fraction of the amount on heating. There is a heating allowance *HA** which would make the tenant indifferent between the optimal consumption when paying the heating bill and satiated heating with a total rent of .3I. If the housing authority's heating allowance is less than *HA**, the tenant is made worse off by paying the heating bill and .3I - *HA* in rent relative to having the landlord pay the heating bill and paying .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 tenants paying utilities separately are calibrated to actual spending, our model predicts that tenants would prefer that utilities are paid by the landlord.

We now turn to landlord incentives based on our description of the assistance programs. Let *FMR* be the agreed on rental rate for a given subsidized apartment between the landlord and the administering agency. When the landlord pays the heating bill, each month the housing authority pays the landlord the difference between the *FMR* and 30 percent of the tenant's income I, plus a heating allowance, HA_{ll}. The tenant pays 30 percent of income to the landlord, but we assume that there is a risk that the tenant will not make the payment. The landlord incurs known administration and maintenance costs $Admin$ (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 as well as the potentially changing price of heat. The landlord's per tenant profits when the landlord pays the heating bill are

$$\Pi_{\text{llpays}} = (FMR - .3I) + E(.3I) - Admin - E(HeatingBill_{\text{ll}}) + HA_{\text{ll}}.$$

There is anecdotal evidence that while the housing authority often adjusts landlord utility allowances upward after years when the 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, losses are likely to be recouped in future years. This suggests that the difference $HA_{\text{ll}} - E(HeatingBill_{\text{ll}})$ is potentially profitable. Additionally, landlord administration costs may be lower when paying the bills, because when tenants pay, landlords may be required to collect bills from tenants for the administering agency's use in determining tenant *HA*.

When tenants pay the heating bill, the amount they pay the landlord decreases by the tenant heating allowance HA_{ten}, while 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 tenant profits when the tenant pays the heating bill are

$$\Pi_{\text{tenpays}} = (FMR - (.3I - HA_{\text{ten}})) + E(.3I - HA_{\text{ten}}) - Admin.$$

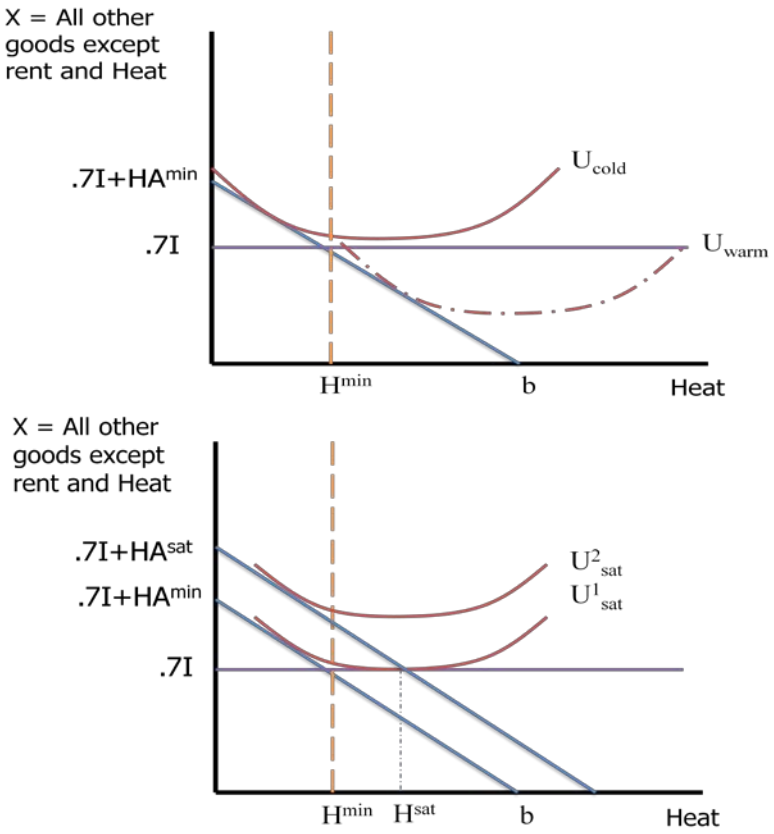
When the tenant pays the contract, the landlord receives a greater proportion of the FMR from the housing authority, which is assumed to pay with certainty, while the tenant may miss rent payments. This would lead the landlord to prefer the regime in which tenants pay the bills.

If tenants never miss rental payments and administration costs are the same under both regimes, the housing authority sets $HA_{\text{landlord}} = E(HeatingBIll_{\text{landlord}})$, and the landlord's profit is the same under both scenarios. Thus, the landlord is indifferent between the two contracts. Our understanding of program implementation suggests that in the building-based programs, administrative costs are lower when landlords pay the bills, and that heating allowances for a particular building are more likely to be increased than decreased. We would expect landlords in these programs to prefer paying bills separately compared to their private market counterparts. In contrast, voucher holders seek out landlords who are less familiar with housing assistance reimbursements for whom tenant pay contracts may represent lower administration costs as a result of fewer increases. We also note that neither scenario encourages landlords to make energy efficiency investments.

We now turn to the policy objectives of administering agencies. Suppose the housing policymaker's objective is that tenants consume at least some minimum quantity of housing and heat at the lowest possible cost to the housing authority subject to the condition that landlords will accept tenants -- that is, landlords receive exactly *FMR* net of any heating bills and heating adjustments. The final condition will require that $HA_{\text{ll}} - E(HeatingBill_{\text{ll}}) = 0$ if landlords pay the heating bill.

Figure 3 represents this policy environment in the context of tenant's consumption. Let H^{min} be the minimum quantity of heat consumption that the housing authority deems acceptable and HA^{min} be the cost of this amount of heat. Under the regime in which the tenant pays the heating bill, the top panel of figure 3, the tenant will consume heat and all other goods at some

3: The housing authority's policy environment



point on the blue budget line. The top panel of the figure shows two possible tenant preferences. A tenant with the solid line preferences will choose to consume less heat than the housing authority target, while a tenant with the dash-dot line preferences will choose to consume more heat and less other goods than the target. Only in the remote case where H^{min} happens to equal the optimal choice bundle (H^1 in figure 1) will both policy objectives be satisfied.

The bottom panel of figure 3 depicts the policy of reimbursing landlords for heating costs that are paid by the landlords. The tenant preferences depicted are such that tenants would choose to consume less than H^{min}, even if the housing authority were to set their allowance at the HA^{sat} amount that it costs the landlords to provide the satiating amount of heat. This demonstrates that reaching the policy goal of achieving above-threshold levels of consumption of heat and all other goods through owner pay contracts is likely to be less expensive than when tenants pay for heat separately. Of course, when the minimum heat consumption boundary is not

binding, increasing consumption of all other goods above the 70 percent of income threshold is less expensive when tenants pay utility bills.

In summary, market forces require private market rents to respond to the increased costs associated with rental contracts in which landlords pay utilities. At the same time, these contracts lead tenants to consume beyond the point where 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 the cost to tenants of housing and utilities for as many tenants as program budgets allow. Under our simplified exposition of current policy, tenants receiving assistance will prefer rental contracts in which landlords pay utility costs, unless the utility allowance provided to 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 up than down, and tenant pay regimes may represent higher administration costs. Finally, a housing authority is more likely to achieve its goals of sufficient utility consumption and spending on housing and utilities at less than 30 percent of income when landlords pay the utilities. However, in our model, this arrangement will be more expensive and result in economic efficiency losses.

III. Empirical analysis

Our empirical analysis first compares the proportion of low-income renters who pay utility bills separately across households who do and households who do not receive government housing assistance. 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 landlord costs or willingness to rent to the tenant and tenant 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 washer and dryer; physical characteristics of the unit that correlate to its energy efficiency or indicate quality such as unit size, number of rooms, presence of a garbage disposal and trash compactor, and if the unit is subject to rent control; building 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 and household location decisions involving a myriad of inseparable goods, while housing policy targets a variety of objectives. In this paper we do not explicitly model how either investment decisions or housing choice responds 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.

We also compare utility expenditures for those low income renters who pay utility bills separately from rent across those who do and those who do not receive government housing assistance. Because our data does 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.[12] We again examine the regression-adjusted differences, controlling for observable differences in units, buildings, and households.

Our data source is the American Housing Survey (AHS) national file. 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 above. The survey also reports if households receive government rental assistance and the local income limits used by housing authorities to determine eligibility for assistance. This allows us to compare renters who receive assistance to similar households who do not receive assistance. Because housing assistance is not considered an entitlement, most qualifying households do not receive benefits. Households report whether utilities are paid separately by the tenant 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

[12] 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.

Table 2: Means of selected variables

	All non-assisted 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

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

significant sample of households drawn from across the country every two years.[13] 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—to establish our control sample. Our analysis is uniformly robust to narrowing the dataset to any given year.

AHS respondents are asked 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 one for an affirmative response to any of these three questions and as zero for a negative response to all. We also examine differences among these response groups 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

[13] While the Residential Energy Consumption Survey (RECS) provides higher fidelity reports of household energy consumption and the associated built environment, the small number of housing assistance recipients in the preclude the use of the survey for this overview. We hope to utilize the AHS and RECS surveys together in extensions of this paper.

certificate or voucher was received; $OtherAssist$ indicates a positive response to receipt of government assistance but a negative response to the other assistance questions. The historical response error in the response to these questions is well documented. The appendix of Shroder (2002) is particularly helpful in assessing the nature of the errors. Citing Casey (1992), he reports that while 91 percent of respondents who actually live in public housing correctly report living in a building owned by the public housing authority, 33 percent of voucher recipients, 42 percent of project-based residents, and 10 percent of eligible unassisted residents incorrectly report living in public housing. Respondents do a somewhat better job of identifying whether or not they receive any assistance, with 81 percent of eligible non-recipients correctly answering that no assistance was received and 3 percent, 17 percent, and 13 percent of public housing, voucher, and project-based recipients incorrectly reporting no assistance. Because of these reporting errors, our comparisons based on self-reported housing assistance status will likely understate actual differences between households who do and do not receive assistance. In our comparisons among different subgroups of assistance recipients, our public housing group will also include project-based and voucher households, our voucher group will also include project-based households, 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 Area Median Income, to create a comparison group of low income households. We group households with reported income at or below the AHS very low income limit variable and who report no housing assistance into in our final group, $Qualify$.

For our first question of the inclusion of utilities in the rent, we restrict our focus to renters. 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 one if the household pays the utility bill separately and zero otherwise. Table 2 reports means of these variables along with a number of control variables for all renters, very low income renters not receiving assistance, and households receiving assistance together and separated by public housing, voucher, and other type of assistance. In spite of the documented misreporting of assistance type, there are large differences between group means for all of our variables. Where 92 and 48 percent of all non-assisted renters pay electricity and gas bills respectively separately from rent, only 77 and 37 percent of households receiving assistance pay

Table 3: Key coefficients for pay utilities separately regressions

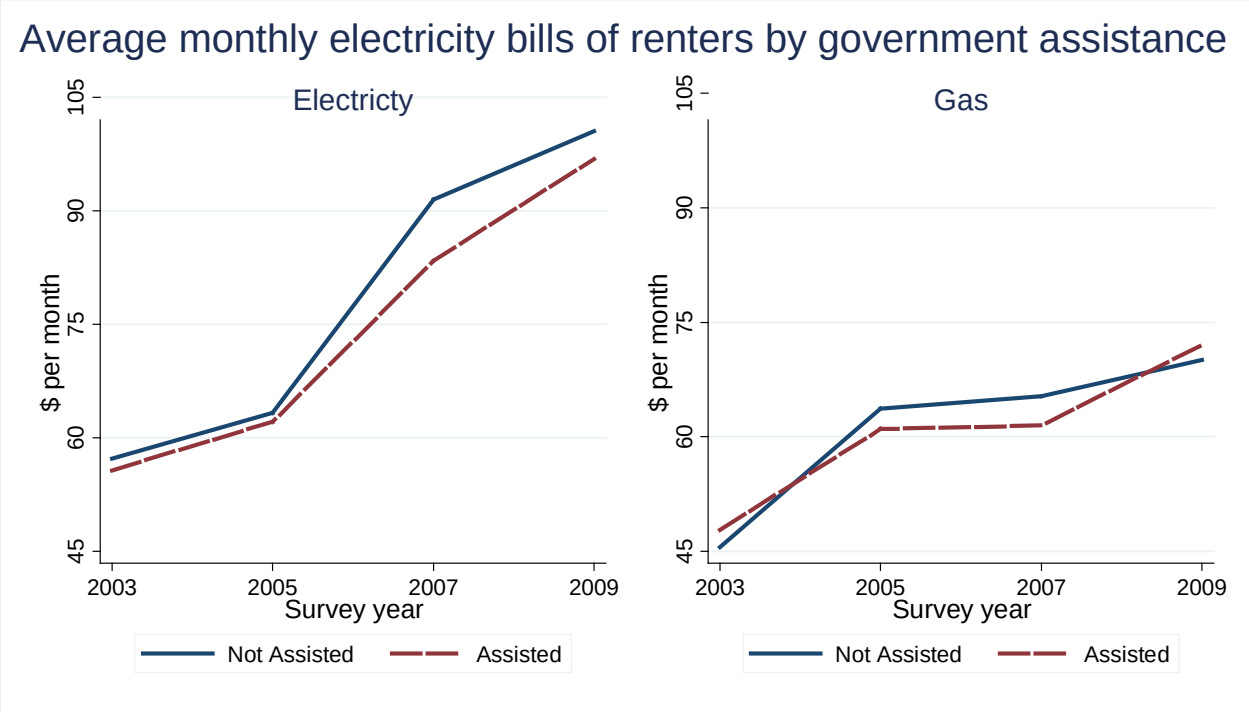
	PayElectric			*PayGas*		
	All renters	**All renters**	**<80% LMI**	**All renters**	**All renters**	**<80% LMI**
GovAssist	-0.107***			-0.064***		
	(0.018)			(0.014)		
Public		-0.206***	-0.198***		-0.097***	-0.101***
		(0.030)	(0.029)		(0.027)	(0.027)
OtherAssist		-0.074***	-0.054***		-0.054***	-0.051***
		(0.018)	(0.016)		(0.014)	(0.016)
Voucher		-0.020*	-0.014		-0.034**	-0.041**
		(0.012)	(0.013)		(0.015)	(0.016)
Qualified	-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

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 parenthesis.

these bills separately. Unlike the other types of housing assistance, which uniformly differ from other renters and the very low income control group, means of all variables for households receiving vouchers are similar to the very low income comparison households, except that voucher holders have larger households, slightly more income, and larger apartments.

We turn to a multivariate regression to assess the extent to which the lower incidence of direct payment of utilities by households receiving government assistance derive from the policy design rather than the population 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 source of fuel and appliance variables that indicate whether the utility is used for heat, hot water, cooking, air conditioning, and drying and whether the unit includes a washer and dishwasher. The second type are 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

Figure 4



decade (a pre-1920 group and decade groups from 1920s through 1960s) or five-year span (from the 1960s to 2005 through 2009) in which the building was built; the number of units, number of units squared—an indicator for being taller than 3 floors; whether the unit is a condo; and indicators for if the unit is rent controlled and if the owner lives on site, and variables indicating if the unit has a garbage disposal and trash compactor. The third group includes occupant characteristics: the number of persons in the household, the log of household income, and race/ethnicity and educational attainment indicators. Finally, we include a rural/urban indicator and fixed effects for metropolitan areas where identifiable in the AHS, and census region by urban status groupings where 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 Table 3, indicate that while some of the difference in the frequency of separate from rent utility billing between subsidized and other households is explained by other characteristics, an economically and statistically significant correlation with assistance remains. Whereas the difference in unconditional means between public housing recipients and non-recipient households is 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.[14] The measured gap for households in the $OtherAssist$ category also decreases but remains substantive, at 7.4 and 5.4 percentage points for $PayElectric$ and $PayGas$. In contrast, differences in the rate at which households receiving vouchers are billed separately for electricity remain indistinguishable from very low income households not receiving assistance, with a marginally significant lower rate from non assisted renters. For $PayGas$, households receiving vouchers are again slightly less likely to pay separately from rent, with a 3.4 percentage point conditional difference relative to non assisted households. In all cases, coefficients do not change materially when the sample is limited to renters with incomes below 80 percent of the local median. The smaller coefficients for the $Voucher$ group, which are statistically different from the coefficients on the other assisted housing group, are consistent with the observed differences, as 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 relative to both public housing authority 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 households receiving rental assistance pay utility bills separately from rent is robust to including controls for observable building and household characteristics and unobservable city characteristics. To the extent that households that have incomes less than 80 percent of the local median but do not report receipt of government housing assistance are otherwise the relevant control group, these regressions suggest that less frequent separate payment of utilities is an outcome of the policy design of housing assistance.

While differences in the frequency of separate payment are robust to a full set of controls, this is not the case for the amount paid in monthly utility bills. As reported in Table 4, among those billed for utilities, the average monthly bills of assisted tenants is not statistically different from the 77 and 61 dollar a month mean for electricity and gas, respectively, paid by all other renters. However, households reporting residence in public housing pay statistically significantly lower monthly bills for electricity while voucher recipients pay a higher amount at 69 and 87 dollars a month respectively. Similar discrepancies exist for gas, with billed public housing and voucher expenses of 58 and 70 dollars.

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

Table 4: 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(1*k*)	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	29,886	2,715	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(1*k*)	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

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
$^{\Delta}$Households in the same group with $PayElectric/PayGas = 0$.

These differences are not robust to the inclusion of unit, building, and household controls. We employ the same variables as controls as in our earlier regressions, except that we now fit geographic time trends in rates. This is motivated by the relatively dramatic increase in utility bills over the survey years shown in Figure 4. Coefficients from the regressions of reported monthly electricity and gas bills on housing assistance group indicators and our control variables are presented in Table 5. With the possible exception of a slight increase in expenditure for electricity among voucher recipients, differences in monthly gas and electricity bills for households receiving government housing assistance and their counterparts are captured by the other characteristics determining expenditure. It does not appear 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. While we do not estimate parameters governing these processes, we have identified a few stylized facts of utilities and subsidized housing in the AHS. First, our results indicate that observed lower rates of gas and electricity billed directly to tenants among households receiving assistance are robust to controlling for factors governing landlord and tenant decisions. This is consistent with incentives for landlords and tenants embedded in housing policy design and the possible policy implication of increased utility costs. Among households paying bills, however, spending differentials between those in public housing, vouchers recipients, and unassisted tenants are not attributable to government programs.

Table 5: Key coefficients from 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				-0.018			
	(0.013)				(0.022)			
Public		-0.031	0.006	-0.030		-0.045	-0.044	-0.070
		(0.021)	(0.021)	(0.023)		(0.035)	(0.036)	(0.037)
OtherAssist		-0.014	0.030	-0.006		-0.015	0.004	-0.011
		(0.020)	(0.020)	(0.020)		(0.033)	(0.038)	(0.040)
Voucher		0.028	0.068***	0.033*		0.003	0.027	0.009
		(0.017)	(0.017)	(0.018)		(0.027)	(0.026)	(0.029)
Qualified	-0.010	-0.010	0.011**	-0.006	-0.004	0.004	0.003	-0.001
	(0.008)	(0.009)	(0.005)	(0.008)	(0.014)	(0.014)	(0.008)	(0.014)
Renter			-0.010**				-0.034***	
			(0.005)				(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

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.

Conclusion

The rules of government subsidy programs can effect utility billing arrangements and expenditures. In this paper, we argue that the programs' treatment of utility expenditures creates incentives for landlords and tenants to prefer that utilities are included in the rent and does not motivate conservation or energy efficiency investment. This is because, among the four primary federal assisted housing programs, utility allowances are targeted to average expenditure so that contract rents do not rise with average utility costs when landlords pay the bills as they would in non-subsidized markets. As a result, tenants will prefer that landlords pay utility bills unless the utility allowance sufficiently exceeds actual spending, and landlords may increase profits if allowances adjust upwards more easily than downwards. 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 of the programs could determine the extent to which they indeed differ.

Using self-reported data from the AHS, 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, tenants who live in public housing are 21 percentage points less likely to pay for their own electricity and 10 percent less likely to pay for gas than low-income renters receiving no assistance. However, the differences are much less pronounced for respondents who report receiving vouchers. This result suggests that landlords with less relative experience with assisted housing programs may be less inclined to include utilities in the rent.

We also look at the differences in energy costs between low-income tenants who pay their utilities in subsidized housing versus those who do not. Our results indicate no significant difference in utility costs between these groups. There are observable differences in mean spending of assisted and non assisted households; however, these differences are attributable to differences in characteristics of the units, buildings, and households rather than government assistance.

Our theoretical and empirical analysis indicates that both landlords and tenants may be influenced by program structures. We also find evidence that some program rules provide little incentive for landlords or tenants to contain costs. These are important issues to tackle as these structures may undermine current and future energy efficiency initiatives. Our results suggest

that incentives for billing arrangements and subsequent energy expenditure embedded in assisted housing programs are relevant to HUD's increased emphasis on sustainability.

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 implementations of program guidelines. Such an analysis will provide guidance into ways programs can incentivize landlords and tenants to reduce utility costs, which will prove beneficial for cost containment in existing programs and the development of future initiatives.

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