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Outsized impacts of residential energy and utility costs on household financial distress

Reid Dorsey-Palmateer
Western Washington University

Abstract

Using data from the American Housing Survey, this paper finds that for renters with limited financial resources, higher average residential energy and other utility costs increase the likelihood of various measures of financial distress such as utility cutoffs and missed rent payments by substantially more than an equivalently sized increase in rent/mortgage costs or an equivalently sized decrease in household income. These negative effects of energy and utility costs on financial distress are also noticeably more pronounced for renters than for homeowners. These results are consistent with prospective residents not fully incorporating future residential energy and other utility costs into their housing selection process and suggests that utility costs, dollar-for-dollar, play a larger role in household financial distress than has previously been realized.

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Contact: Reid Dorsey-Palmateer - reid.dorsey-palmateer@wwu.edu.
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1 Introduction

This paper examines how increased residential energy and other utility bills increase the likelihood of various types of financial distress for households with limited financial resources and, more importantly, how the magnitude of this effect compares to equivalently-sized increases in rent or mortgage payments and equivalently-sized decreases in income. While residential energy and other utility costs often represent a non-trivial share of total housing expenses, earlier work has found evidence that these costs are frequently not fully anticipated when making housing arrangements. If this is the case, then high residential energy and utility costs would be more likely than equivalently-sized but better-anticipated costs to push households towards negative outcomes such as missed rent or mortgage payments or utility disconnection. Using data from the 2017 American Housing Survey, this analysis does find that higher average energy and other utility costs leads to higher likelihood of various types of financial distress for financially constrained renters and that this effect is substantially larger than equivalently sized changes in income, rent, or mortgage costs, as well as being more prominent for renters than homeowners. These results are consistent with and reinforce the prior literature that finds households often do not fully considering energy costs when selecting housing arrangements. Furthermore, these results expand the literature on energy/utility policy and the economics of the household by showing the outsized dollar-for-dollar impact of energy and other utility costs on negative financial outcomes as compared to some other major household budget items. Public policy that increases the salience of energy and utility costs in the renting decision-making process could potentially reduce this outsized impact of additional energy and utility costs on financial distress while simultaneously making the market for housing attributes more efficient.

This work builds on an earlier literature that has studied factors contributing to various types of household financial hardship and distress, often relating to missing bill or rent/mortgage payments. Perhaps unsurprisingly, increases in various types of costs have been found to increase the likelihood of undesirable financial outcomes. For example, increased student loan debt has been found to be associated with a higher likelihood of being over 60 days late with bill payments or being denied credit (Bricker and Thompson (2016)). Hospital admissions have been found to increase unpaid medical bills, risk of bankruptcy and reduced access to credit, among other financial consequences, for insured, non-elderly adults (Dobkin et al. (2018)). Meanwhile, Mazumder and Miller (2016) find that the 2006 Massachusetts health insurance expansion reduced past-due debt and bankruptcies and increased credit scores. However, access to even a relatively low amount of funds substantially reduces the probability of low-income households experiencing hardships such as missed rent or utility payments, food insecurity or having utilities cut off (Mills and Amick (2010)). Gjertson (2016) focuses on savings behavior and finds that making efforts to save money for emergencies reduces the likelihood of future hardships such as skipped utility or housing payments and food insecurity. More generally, behavioral factors, such as patience, planning, and self-control have been found to be related to the likelihood of "struggling to keep up with" bills and credit commitments (McCarthy (2011)).

This study also builds on and contributes to the literature on energy and utility costs and the housing decision making process for both homeowners and renters. These papers generally reach the conclusion that, at least in the contexts examined, the values of some

housing energy efficiency attributes are often unobservable or not salient to prospective renters or homebuyers in the absence of a housing energy efficiency label or score, which are uncommon in the U.S. context. Walls et al. (2017) looks at the impact of energy efficiency labeling on house prices in Austin TX, Portland OR, and the Research Triangle NC areas, finding mixed results. When energy efficiency and "green" certifications are available, house prices are generally increased and in some cases, the price premium approximates the energy savings denoted by the energy efficiency award. Shewmake and Viscusi (2015) study a "green" label partially based on energy efficiency that awards qualifying homes one to five stars and find evidence of a price premium from being awarded additional stars, but not from an increase in the underlying score that does not result in an additional star being awarded. Cassidy (2018) finds that mandating disclosure of the results of a housing energy efficiency audit to prospective home-buyers, as is done in Austin, increases the capitalization of various energy efficiency features into the home price and that this effect is stronger for energy efficiency features that would be more difficult for a prospective buyer to observe on their own. While these papers focused on houses for purchase, 35.9% of occupied U.S. housing units were renter-occupied in 2019 Q2 (US Census Bureau (2019)). Earlier work has also examined the attention paid by prospective renters to future housing energy costs. Myers (2018) uses changes in the relative price of heating fuels to find that information asymmetries exist between landlords and tenants with respect to energy costs for rental units. More generally, the lack of attention to future energy bills for prospective renters is a key input to the well-known "landlord-tenant" problem where landlords may not undertake energy efficiency upgrades that would lower overall energy costs by more than the cost of the upgrade if they do not believe that they would be able to recover their costs through increased rents (Allcott and Greenstone (2012)).

The remainder of the paper proceeds as follows. Section 2 discusses the data used for this study. Section 3 covers a theoretical model of financial distress and its application to the empirical analysis. Finally, section 4 concludes.

2 Data

The data for this analysis comes from the 2017 American Housing Survey (AHS), run by the U.S. Census. The AHS is a biennial survey of American housing units with data on both the housing units themselves and on characteristics of the households occupying them. Importantly for this analysis, the 2017 version of the AHS contained questions on four topics in addition to the standard ones: delinquent payments, disaster preparedness, commuting, and evictions. Household-level data on energy and other utility costs, rent or mortgage costs, and household income over the past year as well as household size are also available through the 2017 AHS, as well as age and education level of the head of the household.

The household financial distress variables used in this analysis are from the 2017 AHS's 'delinquent payments' questions, which, in part, ask residents of the housing units being surveyed if each of the following events have occurred in the past three months: receiving a threat to have utilities shut off, actually having a utility shut off, missing a rent or mortgage payment, and receiving an eviction threat.[1] The choice of these variables to represent house-

[1]Data on eviction threats are for renters only; the equivalent data for homeowners was not publicly available.

hold financial distress status is in line with other related papers in the literature, where not paying bills such as utilities, rent or mortgage payments is a common indicator of household financial distress.

This analysis is limited to households that are financially-constrained, meaning here that they had relatively limited access to funds through either savings or credit cards. The 2017 AHS question used to determine if a household is financially constrained is in the disaster preparedness section: *"If you had to evacuate from your town or city to a safe place at least 50 miles away, do you have the financial resources, in terms of savings or available credit card balances, to meet expenses of up to $2,000?"* About 22% percent of households (40% of renters and 12% of homeowners) are financially constrained according to this measure.[2] I drop those who answered "yes" to this question from the analysis as households with access to $2000 will generally be able to avoid the types of financial distress outcomes being studied.[3] The AHS data, as well as this analysis, does not address why these households do not have access to $2000 for an evacuation; a substantial share of the U.S. population essentially lives "paycheck-to-paycheck" for a variety of reasons.

Because a key contribution of this analysis is comparing the impact of energy and other utility costs on household financial distress to that of housing (rent or mortgage) costs and income, only homeowners who have mortgage payments are included. I also restrict observations to houses, mobile homes or apartments, eliminating the less conventional housing types also covered by the AHS.

3 Analysis

Theoretically, the probability of a household being in some kind of financial distress in any given month is related to that month's income, expenses, and their available stock of financial resources, in addition to financially-related behavioral characteristics. Different types of expenses, income and financial assets can also have different levels of salience to the household members when budgeting and spending during the month and thus do not equally contribute to the probability of financial distress. The probability of household i being in some kind of financial distress in month t is then

$$P(FinDistress_{it}) = f(Expenses_{it}, Income_{it}, FinAssets_{it}, Behavior_{it}) \tag{1}$$

where $FinDistress_{it}$ is a 0/1 indicator of whether the household is in financial distress that month and $Expenses_{it}$, $Income_{it}$, $FinAssets_{it}$, *and* $Behavior_{it}$ are types of expenses, income, financial assets and finance-related household behavioral characteristics. Note that we do not assume that all types of expenses, income and financial assets have the same dollar-for-dollar impact on the probability of financial distress. It is unclear theoretically what form

[2]This data is consistent with Durante and Chen (2019), which found that in 2018 39% of American adults would not be able to (or would not choose to) cover a hypothetical unexpected $400 expense using cash, savings, or a credit card that would be paid off in full the next month and that 12% of American adults do not believe they would be able to pay for the hypothetical $400 expense at all, even with a credit card that would not be paid off the following month.

[3]Note that the disaster preparedness questions, including the one concerning access to $2000, were only asked to half of the 2017 AHS respondents; the other half were asked the commuting questions. The 2017 AHS contains a weighting variable specifically for use when using the subset of observations that were asked the "disaster preparedness" questions, which was used in this analysis.

this function should take, though we would expect higher expenses and lower incomes and financial assets to increase the probability of financial distress. Because our objective is to estimate the marginal impact of key inputs (and how they differ) on the expected probability of household financial distress given observable household characteristics, $\frac{\delta E[P(FinDistress_{it}=1)|X]}{\delta X_{it}}$, we will use the linear probability model (LPM) as our preferred specification because the LPM provides the best linear approximation to the conditional expectation function, in a least-squared error sense. One alternative approach in estimation would be to assume that the function determining the probability of financial distress takes the form of the standard normal CDF and that the inputs to this function are additive; using this assumption in our identification would allow us to estimate these impacts via the probit model.[4] The results of this analysis are robust to using probit instead of LPM.

To analyze how residential energy and other utility costs are related to various types of financial distress and how this effect compares to that of housing (rent or mortgage) costs and income, I estimate the following linear probability model for financially constrained households in the 2017 AHS:

$$\begin{aligned} FinancialDistress_i &= \alpha + \beta_1 MonthlyUtilityCosts_i + \\ &\quad \beta_2 MonthlyIncome_i + \beta_3 MonthlyRentOrMortgageCosts_i + \\ &\quad \beta_4 HouseholdSize_i + \beta_5 Age_i + \beta_6 MedicareEligible_i + \\ &\quad \boldsymbol{\gamma Education}_i + \boldsymbol{\tau CensusDivision}_i + \epsilon_i \end{aligned} \tag{2}$$

Four binary financial distress variables covering the three months prior to the interview are separately used: receiving a threat to shut off a utility such as water or electricity, actually having a utility be shut-off, missing a rent or mortgage payment, and receiving an eviction threat.[5] The dependent binary financial distress variables are coded to be one if the respondent reported experiencing that type of financial distress in the prior three months and zero otherwise. Higher costs – either rent, mortgage, or utility – as well as lower household income could increase the likelihood of experiencing one of the financial distress outcomes by either increasing the size of various bills to be paid or reducing the amount of income that could be used to pay them. The size of the household is also included in the specification as additional people in a household incur more expenses. I also include the age and level of education of the head of household, as these could be related to unobserved financial sophistication and the likelihood of experiencing financial distress. A separate age-related variable, $MedicareEligible$, is set equal to one if the head of household is age 65 or older and zero otherwise; this captures a reduction in out-of-pocket health care costs due to Medicare eligibility. Indicator variables for the Census division of the household (e.g., New England, Middle Atlantic, Pacific, etc.) are also included. The main empirical results are robust to

[4]One benefit of the probit model is that the predicted probabilities for household financial distress would be constrained to be between zero and one, which is not true under the LPM. However the objective of this work is to estimate the impact of changing inputs such as utility payments, rent, income, etc. on the probability of financial distress and given that we do not know the true form of $f(.)$ and would prefer not to use an arbitrary distributional assumption in our estimation, we will emphasize the best linear approximation to it.

[5]Eviction threat data is for renters only due to data limitations.

excluding the non-financial variables, as will be discussed later. Heteroskedasticity-robust standard errors are used, as are AHS survey weights that account for limiting observations to those asked the "disaster preparation" questions.

The model is estimated separately for renters and homeowners with a mortgage because these two groups likely on average have different levels of unobserved financial sophistication and other finance-related behavioral characteristics which could affect the relationship between expenses, income, and the likelihood of financial distress. Additionally, prospective home buyers are likely to put forth more effort into their housing selection decision than renters due to the larger financial implications of purchasing versus renting, and thus may more strongly consider utility/energy costs in their housing selection decision. Overall, we would expect the impact of higher utility costs on the probability of financial distress to be higher for renters due to these factors.

Coefficient estimates for financially-constrained renters can be found in Table I. Higher average monthly energy and other utility costs are associated with a statistically significant increase in the probability of receiving utility shut-off threats, actually experiencing utility shut-offs and missing rent payments, though not for receiving eviction threats (which are less common overall than the other financial distress outcomes). Higher income is also associated with a statistically significant decrease in the likelihood of all four types of financial distress variables. Interestingly, higher rent payments were not found to have a statistically significant effect on the probability of any of the four financial distress variables; a potential explanation for this is that rent costs are more predictable than either utility costs or income and can thus be better incorporated into decision making.[6]

Perhaps most interestingly, an increase in average utility costs had an substantially larger impact on the probability of financial distress than an equivalently sized decrease in income or increase in rent costs for the three outcome variables that average utility bills had a statistically significant impact on. For example, a $100 increase in average monthly utility payments is associated with a 5.1 percentage point increase in the probability of receiving a utility shut-off notice, a 3.3 percentage point increase in the probability of experiencing an actual utility shut-off and a 2.5 percentage point increase in the probability of missing a rent payment. Meanwhile, a $100 decrease in monthly income is associated with approximately just a 0.1 percentage point increase in the likelihood of all these occurrences. As noted earlier, an increase in rent costs was not associated with a statistically significant change in the probability of experiencing any of the financial distress outcomes. All these differences in the magnitude of dollar-for-dollar impact on financial distress probability are statistically significant, as tested using the null hypotheses that (a) the "monthly utility payment" coefficient is equal to the inverse of the "monthly income" coefficient and (b) the "monthly utility payment" coefficient is equal to the "monthly rent payment" coefficient.

[6]Durante and Chen (2019) find that about a third of U.S. households have income that varies from month to month. The AHS income data used in this analysis is household income over the past 12 months (converted to a monthly average) and does not include information on how variable that income was.

TABLE I: Effects of Monthly Costs and Income on Probability of Financial Distress for Renters

	Utility Shutoff Notice	Actual Utility Shutoff	Missed Rent Payment	Eviction Threat
β_1: Monthly Utility Payment ('000s)	0.51***	0.33***	0.25**	-0.02
	(0.101)	(0.100)	(0.098)	(0.043)
β_2: Monthly Income ('000s)	-0.010***	-0.0078***	-0.011***	-0.0031***
	(0.0029)	(0.0027)	(0.0030)	(0.0010)
β_3: Monthly Rent ('000s)	-0.006	-0.005	0.002	-0.004
	(0.014)	(0.014)	(0.010)	(0.004)
Number of People in Household	0.0094	0.0099	0.0057	0.0053
	(0.0067)	(0.0065)	(0.0056)	(0.0036)
Age of Respondent	0.0007	0.0003	0.0004	0.0005
	(0.0007)	(0.0007)	(0.0006)	(0.0004)
Medicare Eligible	-0.0874***	-0.0450	-0.1066***	-0.0420***
	(0.0298)	(0.0285)	(0.0233)	(0.0138)
Did Not Complete High School	0.0043	0.0014	-0.019	-0.014
	(0.023)	(0.022)	(0.023)	(0.009)
Some College	0.046**	0.034*	0.028	0.016
	(0.021)	(0.020)	(0.018)	(0.010)
College Graduate	-0.012	-0.012	-0.019	-0.018**
	(0.038)	(0.027)	(0.024)	(0.009)
Graduate School	-0.034	-0.059**	-0.031	-0.016
	(0.038)	(0.030)	(0.030)	(0.010)
Linear Restrictions				
H0: $\beta_1 = -\beta_2$	***	***	**	-
H0: $\beta_1 = \beta_3$	***	***	**	-
Observations	4423	4423	4423	4423

Dependent variables are 0/1 indicator variable equal to one if the household has experienced the specified type of financial distress within the past three months. All financial variables in thousands of dollars. Omitted education level for head of household is "High School Grad". Constant term and controls for Census division omitted. Linear restrictions separately test the null hypotheses that the dollar-for-dollar effect of increased utility bills are equal to the effect of decreased income and the effect of increased rent payments. Heteroskedasticity-robust standard errors in parentheses. Observations restricted to renters who reported they could not pay for $2000 of expenses via savings or credit cards if an evacuation was necessary. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Coefficient estimates for financially-constrained homeowners with a mortgage can be found in Table II. For these households, higher average utility costs do not have a statistically significant impact on the probability of receiving utility shut-off threats, experiencing actual utility shut-offs, or missing housing (in this case, mortgage) payments, although for in all three cases the estimated coefficient is still positive. When compared to the equivalent results for renters, the impacts of average energy and other utility costs as well as income on the various financial distress outcomes are generally of smaller magnitude. This is consistent with differences in unobserved financial-related behavioral characteristics between renters and homeowners that mitigate the impact of higher utility costs on the likelihood of financial distress for homeowners. Additionally, note that there are substantially fewer observations for the homeowner regressions as the renter regressions.

The non-financial variables (age, Medicare eligibility and educational background of the head of the household, size of the household, and Census district of the household) were, for the most part, statistically insignificant in both Tables I and II. The key results for the financial variables discussed above are robust to not including the non-financial variables at all, as seen in Table III.

TABLE II: Effects of Monthly Costs and Income on Probability of Financial Distress for Homeowners

	Utility Shutoff Notice	Actual Utility Shutoff	Missed Mortgage Payment
β_1: Monthly Utility Payment ('000s)	0.25	0.22	0.11
	(0.15)	(0.15)	(0.13)
β_2: Monthly Income ('000s)	-0.002*	-0.0012	-0.0030*
	(0.001)	(0.001)	(0.002)
β_3: Monthly Mortgage Payment ('000s)	0.0037	0.0039	-0.0003
	(0.0034)	(0.0031)	(0.0014)
Number of People in Household	-0.008	-0.0016	-0.0019
	(0.010)	(0.010)	(0.010)
Age of Respondent	0.0007	0.0007	0.0011
	(0.0014)	(0.0013)	(0.0013)
Medicare Eligible	-0.105**	-0.098**	-0.110***
	(0.049)	(0.046)	(0.042)
Did Not Complete High School	0.033	0.044	-0.075**
	(0.055)	(0.054)	(0.033)
Some College	-0.032	-0.048	-0.020
	(0.033)	(0.032)	(0.033)
College Graduate	-0.007	-0.033	-0.0073
	(0.044)	(0.040)	(0.042)
Grad School	-0.045	-0.049	-0.038
	(0.053)	(0.051)	(0.051)
Linear Restrictions			
H0: $\beta_1 = -\beta_2$	-	-	-
H0: $\beta_1 = \beta_3$	-	-	-
Observations	1034	1034	1034

Eviction threat data not publicly available for homeowners (unlike renters). Dependent variables are 0/1 indicator variable equal to one if the household has experienced the specified type of financial distress within the past three months. All financial variables in thousands of dollars. Omitted education level for head of household is "High School Grad". Constant term and controls for Census division omitted. Linear restrictions separately test the null hypotheses that the dollar-for-dollar effect of increased utility bills are equal to the effect of decreased income and the effect of increased mortgage payments. Heteroskedasticity-robust standard errors in parentheses. Observations restricted to homeowners with a mortgage who reported they could not pay for $2000 of expenses via savings or credit cards if an evacuation was necessary. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

TABLE III: Robustness Checks

	Utility Shutoff Notice (Renters)	Actual Utility Shutoff (Renters)	Missed Rent Payment (Renters)	Eviction Threat (Renters)	Utility Shutoff Notice (Owners)	Actual Utility Shutoff (Owners)	Missed Mortgage Payment (Owners)
β_1: Monthly Utility Payment	0.63***	0.45***	0.34***	0.032	0.24*	0.24*	0.092
	(0.088)	(0.084)	(0.084)	(0.037)	(0.14)	(0.13)	(0.11)
β_2: Monthly Income	-0.0092***	-0.0072***	-0.0090***	-0.0023**	-0.0020**	-0.0012	-0.0027**
	(0.0028)	(0.0026)	(0.0027)	(0.0010)	(0.00095)	(0.00087)	(0.0013)
β_3: Monthly Rent/Mortgage Payment	-0.0089	-0.0090	0.00033	-0.0031	0.0024	0.0024	-0.0021
	(0.014)	(0.014)	(0.0090)	(0.0036)	(0.0042)	(0.0039)	(0.0016)
Linear Restrictions							
H0: $\beta_1 = -\beta_2$	***	***	***	-	*	*	-
H0: $\beta_1 = \beta_3$	***	***	***	-	*	*	-
Observations	4423	4423	4423	4423	1034	1034	1034

Eviction threat data not publicly available for homeowners. Dependent variables are 0/1 indicator variable equal to one if the household has experienced the specified type of financial distress within the past three months. All financial variables in thousands of dollars. Constant term and controls for Census division omitted. Linear restrictions separately test the null hypotheses that the dollar-for-dollar effect of increased utility bills are equal to the effect of decreased income and the effect of increased rent or mortgage payments**.** Heteroskedasticity-robust standard errors in parentheses. Observations restricted to renters/homeowners who reported they could not pay for $2000 of expenses via savings or credit cards if an evacuation was necessary. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4 Conclusions

This paper has found that for financially-constrained renters, increased average residential energy and other utility costs increase the likelihood of several measures of financial distress and that these effects are substantially larger than for an equivalent increase in rent or mortgage costs or an equivalent decrease in income. One potential explanation for this, consistent with the previous literature, would be prospective renters not fully incorporating future residential energy and other utility expenses into their housing selection decision. Additionally, these negative effects of higher utility bills on the probability of financial distress are generally more pronounced for renters than homeowners, which would be consistent with prospective homeowners paying relatively more attention to future energy and utility costs, as well as homeownership capturing additional financial sophistication more generally. These results contribute to our understanding of causes of household financial distress and suggest that utility costs, dollar-for-dollar, play a larger role in household financial distress than has previously been realized. Determining the exact mechanism by which this different impact occurs is a promising avenue for future research.

These results are based on average household utility costs as data on monthly bill variation was not available. Investigating the potential role monthly variation plays in causing the larger impact of utility costs on financial distress (and thus potential benefits of billing practices which smooth out this variation) is one topic for future research. Additionally if this result is due, at least in part, to a lack of attention to these costs during the housing selection process, then one potential way to address this issue could be policies that encourage greater understanding of energy and other utility costs during the housing selection process. These could include mandating disclosure of energy efficiency audit results or revealing historical utility bills. While the traditional justification for these types of policies is to incentivize energy efficiency investments by making them appropriately valued in the housing market, future research could also study the extent to which increased understanding of expected energy and other utility costs during the housing selection process affects the subsequent ability of residents to avoid financial distress.

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