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What Are the Benefits of Government Assistance with Household Energy Bills?

Evidence from Ukraine

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Abstract

In April 2015, the Government of Ukraine abruptly raised the tariffs of natural gas to residential customers, which were previously well below the cost of acquiring gas and delivering it to households. The tariff increase—700 percent—caused considerable distress to the population and led the government to scale up its existing energy assistance program, the housing and utilities subsidy program. This paper examines the welfare effect of the program and potential redesigns of the program. Using several waves of Ukraine's Household Budget Survey, the analysis finds that electricity, gas, and fuels account for a considerable share of household income. After the tariff hike, the average household that did not receive the housing and utilities subsidy spends 11 percent of its income on electricity, gas, and fuels, implying that it meets the definition of "fuel poor." The average share for households that do receive the subsidy is 6–8 percent. The housing and utilities subsidy cuts the rate of fuel poverty in half. It also brings considerable consumer surplus gains of 6–7 percent of income. This comes at a high price tag for the government, as the budget for the housing and utilities subsidy is 1–2.5 percent of gross domestic product. Considerable savings would be achieved with only a small loss of consumer surplus if the housing and utilities subsidy was cut in half. Linking the subsidy solely to income would also attain considerable savings, but at a high loss of welfare. The housing and utilities subsidy could also be paired with social tariffs, or an energy efficiency subsidy, with major savings for the government.

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1. Introduction

Fuel subsidies consumed $4.7 trillion worldwide—or 6.3% of global GDP—in 2015 and are projected to remain large in the near future (Coady et al., 2019). Fuel subsidies occur when the government imposes that fuels or electricity be sold at prices below the marginal and/or average cost of producing and distributing them to customers, or when a preferential tax rate is applied to a specific fuel. For example, diesel is in many countries subject to a different tax rate per liter than gasoline (Coady et al., 2018).[2]

The fuel subsidies are usually motivated by the desire to help poorer households, achieve full electrification, and protect the standard of living and health of the population. A large body of research, for example, has linked insufficiently heated dwellings to higher wintertime morbidity and mortality for their occupants (e.g., Clinch and Healy, 2000; Aylin et al., 2001; World Health Organization, 2018; Huebner et al., 2019).

Subsidizing energy inputs however leads to excessive consumption, which has adverse environmental consequences, and insufficient revenues, which in turn lead to substandard supply, service interruptions (which hurts the entire economy; Timilsina et al., 2018), and inadequate investment in production, transmission and distribution infrastructure (McRae, 2015; Hancevic et al., 2016). Subsidies contribute to inequality, foment social unrest (Goncharuk and Cirella, 2020), reduce welfare (Hahn and Metcalfe, 2021), and limit fiscal space for other public sector interventions (Coady et al., 2015).

In recent years, several countries have undertaken energy pricing reforms in an effort to reduce or eliminate fuel subsidies. For example, starting in 2016, Argentina gradually removed

[2] Kotchen (2021) examines the subsidies implied by the fact that fossil fuel prices do not include the environmental public health and transportation externalities associated with their use. He calculates that US suppliers of natural gas receive subsidies equivalent to some 18% of the net income from continuing domestic operations for the median natural gas and oil producer in 2017-2018, and that they exceed net income for the majority of coal producers.

the subsidies on natural gas and electricity for residential customers, and was thus able to reduce the subsidies' share of GDP by more than half, from 3.5% in 2014 to 1.4% in 2019 (Giuliano et al., 2020). Busheiri and Wohlgenant (2012) examine the effects of removing the price subsidies for residential electricity in Kuwait, which as of 2008 accounted for some 4% of GDP.

Repealing energy subsidies may also be part of policies aimed at reducing CO_2 emissions. Rosas-Flores et al. (2017) predict the price increases that would be experienced under three policy scenarios in Mexico, namely i) the complete removal of subsidies on electricity, liquified petroleum gas (LPG) and gasoline, ii) a 50% reduction of them, and iii) removal of the subsidies on gasoline and LPG only, plus the introduction of a carbon tax, with the electricity tariffs unchanged.

Whether based on consumer welfare (Busheiri and Wohlgenant, 2014), the energy bills' shares of household income or expenditures (Fankhouser and Tepic, 2007), other measures of concentration of the subsidies by income group (Giuliano et al., 2020), or computable general equilibrium models (Orlov, 2017), assessments depend crucially on the price elasticity of demand (Rosas-Flores et al., 2017; Durmaz et al., 2020) and on opportunities for substitution between fuels (Rosas-Flores et al., 2017; Krauss, 2016).

Most of these analyses show that energy pricing reforms produce losers, raising an important welfare issue: How should they be implemented to correct inefficiencies while protecting low-income households and thus ensuring that basic energy needs are affordable during the reform and beyond? Typically, this involves some form of targeted welfare program or non-linear pricing structure that penalizes high-volume consumers (assumed to be wealthier) and subsidizes low-volume consumers (assumed to have low incomes). To a large extent depending on the targeting accuracy and generosity, welfare interventions present a cost-benefit trade-off that must be compared against a baseline of universal subsidies or against alternative interventions. International organizations and donor agencies, such as the World Bank or the International Monetary Fund, generally rely on comparing fuel poverty across scenarios and/or the distribution of government assistance under different compensation schemes (Laderchi et al., 2013).

This paper focuses on the energy price reforms that took place in Ukraine in 2015-16, and on the measures introduced by the government to soften the impact of the extreme tariff hikes. As of 2015, the implicit subsidies on the price of natural gas accounted for some 7% of GDP. The universal nature of these implicit subsidies means that heavy users of natural gas—whether wealthy or otherwise—received a disproportionate share of them (Coady et al., 2015). In 2015, on advice from the International Monetary Fund, and after internal disruptions and conflict with the Russian Federation, the natural gas tariffs to residential customers were abruptly raised to help bring them in line with the price of gas on the international market. Within a matter of months, the price of natural gas—the main source of heat, hot water and cooking fuel for most Ukrainians living in urban settings—increased seven-fold. The price of district heating, which supplies some 20%-30% of the population, was likewise raised.

To reduce the burden that such tariff increases brought to the population, the government revamped and scaled up the existing means-tested energy assistance program—the Housing Utilities Subsidy, or HUS. Enrollment in the program spiked up around September 2015, and the HUS is estimated to have covered at certain times up to 40%-50% of the households. It quickly became the largest social assistance program in Ukraine, costing around 2.5% of GDP.[3] Until 2019, the subsidies—which are calculated according to a non-linear formula based on income and normative consumption—did not involve any cash transfers to the households: They were

[3] In 2016, for example, HUS disbursements to households totaled 52,600 million UAH, or some 13% of all social protection programs in Ukraine (Bornukova et al., 2019).

simply deducted from the household's bills. In May 2019, the government started "monetizing" the subsidies, which means that the households actually receive them as cash transfers.

The HUS design provides interesting insights, as it combines two targeting elements not typically applied jointly to target vulnerable customers with high energy burden—income assessment and the expected volume of energy consumption. In this paper we examine the effect of this energy assistance program, as well as program design trade-offs that may be helpful with future tariff reforms and energy markets. We ask three research questions. First, did the assistance program offset the tariff hikes and provide relief for the most vulnerable segments of the population? Second, did the assistance program end up helping heavy (and potentially wealthier) consumers, namely those that were already taking advantage of the artificially low price of natural gas before the tariff reforms? Third, are there alternative, more targeted designs for the HUS that perform better in terms of cost to the government and welfare effects? Should the HUS be paired with social tariffs to make it more sustainable?

We answer these research questions using up to five waves of Ukraine's Household Budget Survey. Attention is restricted to natural gas consumption in households that use natural gas for space heating. These are almost half of the households in Ukraine, and this share is likely to grow in the future as more municipalities switch away from district heating. We use three main metrics. Specifically, we examine the gas bills as a share of household income and/or expenditure, the share of the population that experience fuel poverty, and the consumer surplus change from removing the HUS or redesigning it. We pay special attention to how these metrics vary across the joint distribution of income and gas consumption. A key feature of our analyses is that while the original, artificially low natural gas tariffs provided *untargeted* subsidies to all households, the HUS and variants of it considered in this paper are a form of *targeted* assistance or subsidies.

Briefly, the data show that Ukrainian households spend a non-negligible portion of their incomes on electricity, natural gas and other domestic fuels. Even among those households that are not considered eligible for government assistance, energy expenditure account for some 11% of household income. In other words, the average non-assisted household would be considered fuel poor by conventional standards, in that energy expenditures account for 10% or more of income (UK DECC, 2013). The data further confirms that households availed themselves of the HUS at a high rate—even when comparatively well off.

The HUS did help reduce the burden of the residential energy bills, managing to reduce the energy bills' share of income (or of total expenditure) by as much as 10 percentage points and cutting the fuel poverty rate in half. One-third of the households however meet the definition of fuel poor, even with the HUS in place.

We calculate the welfare effect of the HUS as the (negative of the) loss in consumer surplus that would be experienced if the HUS were removed. Using two alternate approaches, we quantify that to be of the order of 1,800 – 2,200 UAH per household per year (2014 UAH), or 6%-7% of net income. The two approaches differ in the intensity of such loss across the joint distribution of income and gas consumption but are in agreement that the poorest families' consumer surplus gains are 5%-14% of income, those of middle-income families 4%-7%, and those of the wealthiest families 2%-4%. We further experiment with simple variations on the design of the HUS, including halving it or making it targeted to poor consumers (regardless of their consumption level), and find that halving it, for example, would imply a small loss of welfare while saving considerable government funding.

The remainder of this paper is organized as follows. Section 2 presents background information. Section 3 describes the data and section 4 our methods. Section 5 presents the results and section 6 concludes.

2. Background

Ukraine has experienced a number of tariff reforms over the 1990s and in the early 2000s, like other transition economies and former Soviet Republics (Fankhouser and Tepic, 2007; Ersado, 2012; Krauss, 2016), but has remained a highly energy-intensive, energy-inefficient country where natural gas was supplied to households at tariffs below cost.[4] In Ukraine, the residential natural gas tariffs are set exogenously by the regulator and generally remain unchanged for about a year. Unlike in the United States, they do not adjust monthly to mirror the higher or lower cost at which the utility has acquired natural gas (Auffhammer and Rubin, 2018).[5] Over the course of three years (from 2013 to 2016) gas prices to residential customers increased dramatically—by over 700% in nominal terms—in part because of the deteriorating relationship, and eventual conflict, with Russia, which canceled deliveries to Ukraine, and in part to help the gas utility, which had until then been selling natural gas for industrial and residential use at highly subsidized rates, recover costs.[6]

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[4] As of 2016, Ukraine relied on fossil fuels (coal and natural gas) for more than two-thirds of its energy needs (https://www.eia.gov/international/analysis/country/UKR), on nuclear power for about 23%, and on oil for some 10%. Renewables accounted for only 3% of Ukraine's energy needs.

[5] Gas prices were regulated by the National Commission for State Regulation of Energy (NERC) from October 23, 2011 to October 1, 2015. The Ukrainian Cabinet of Ministers has been regulating the price of gas as an "energy carrier" ever since, while NERC retains the authority to set prices for gas distribution and transmission.

[6] Prior to the 2015 tariff reforms, Ukraine had the lowest household gas prices in the industrialized world and its economy had a degree of energy intensity comparable to that of Russia, but "without the latter's natural resource endowment" (Emerson and Shimkin, 2015, p. 3). Calculations by Fankhauser and Tepic (2007) based on pre-2006 data show that Ukrainian households were, on average, able to pay their utility bills "without problems," and that affordability would have remained very good even if tariffs had been raised to ensure cost recovery in 2007.

Until March 2015 consumers faced a fairly complicated one-part, increasing block rate tariff scheme based on annual consumption with a mid-year assessment.[7] This scheme was replaced in April 2015 by a two-block system during the heating season, with the block cutoff set at 200 m^3 per month, and uniform pricing (and a dramatically higher rate per m^3) the rest of the year. A consumer who used exactly 200 m^3 would have paid (1.089×200)=217.80 Ukrainian hryvnias (UAH) in March 2015, but (200×3.6)=720 UAH in April 2015. A consumer using 400 m^3 would have paid (200×1.089+200×1.788) =575.40 UAH in March 2015, but (200×3.6+200×7.188)=2,517.60 UAH in April 2015.

In April 2016, the block system was dropped, and a uniform pricing scheme introduced. The rate was set at 6.879 UAH/m^3, seven times as much as what our 200-m^3/month customer would have paid only 13 months earlier.[8] In April 2017, the tariff was slightly raised to 6.958 UAH/m^3. This tariff remained in place until October 2018, and in November 2018 was replaced by 8.549 UAH/m^3. The rates were reduced in 2019 and 2020 and starting from August 2020 consumers were allowed the choice of their gas supplier.[9]

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[7] To illustrate, initially there were a total of four blocks—from zero to 2,500 m^3/year, from 2,500 to 6,000 m^3/year, from 6,000 to 12,000 m^3/year, and more than 12,000 m^3/year. Suppose that a household in one year used 2,000 m^3. At the beginning of the next year, the household would be charged the first-block rate for each m^3 consumed in each month. At the end of June, the utility would re-evaluate this household. If the household had used less than 60% of the block cutoff (namely, 0.60·2500=1500 m^3), it would continue to be charged the first-block rates. If it had exceeded that cutoff (having consumed, for example, 1,850 m^3), it would be bumped up to the second-block rate. At the end of the year, if the consumer had managed to stay below 2,500 m^3, it would be assigned the first-block rate starting the next January, while if it had consumed between 2,500 and 6,000 m^3 over the year, it would be assigned the second block rate. This scheme was slightly simplified, and rates raised somewhat, in May 2014, when the regulator did away with the upper block, as can be seen in table 1. In April 2015, the scheme was replaced by a two-block system. The cutoff between the first and second block was set at 200 m^3 *per month*. The block system was dropped entirely in April 2016.

[8] The exchange rate was 28.77 UAH per euro on April 15, 2016 (see https://freecurrencyrates.com/en/exchange-rate-history/EUR-UAH/2016/nbk).

[9] The tariffs are inclusive of 20% Value Added Tax (VAT). In 2018, for example, when the price of gas was stable and averaged about 7.25 UAH/m3, the VAT was on average 2.21 UAH/m3. This amount is roughly comparable to a hypothetical carbon tax of $25/ton CO_2, which would translate to 1.17 UAH/m^3, since one cubic meter of natural gas contains about 1.68 kg of CO_2. Ukraine does have a carbon tax, but the rate is only 10 UAH/ton CO_2, and the tax is levied only on entities that emit more than 100 tons of CO_2 per year.

Electricity tariffs likewise rose during the same four-year period, but at a much lower rate (no more than 50% from one tariff regime to the next) and more frequently (Alberini et al., 2019). District heating tariffs vary across locations and district heating companies, but perusal of the variable tariff per gigacalorie (the unit of measurement for district heating) shows that they quadrupled in 2017 and quintupled in 2018, compared to their 2013 levels.[10]

What we have described above are the rates for regular residential customers. In practice, in Ukraine persons in certain professions (e.g., civil servants, the military, retirees, veterans, Chernobyl decontamination workers) receive so-called "benefits" (or "privileges"), namely discounted tariffs for the portion of their gas consumption that falls below a specified "allowance." The allowance is calculated by the government following a precise formula that takes into account family size, dwelling size, the number of stories of the building, whether gas is used for heating, cooking and/or hot water, and is seasonally adjusted. The allowances thus create additional tiers and the discounts with respect to the regular tariffs bring additional variation in rates.[11]

The sharp increases in natural gas rates for residential customers in April 2015 and a year later triggered massive increases in the prices of many other goods and the consumer price index and were a major cause of distress among the population. Government assistance however was, and still is, available, to help families pay their utility bills. The government assistance, or "Housing and Utility Subsidy" (HUS), varies across eligible households and is effectively a lump-sum transfer meant to help cover the utilities. Until May 2019, households did not actually

[10] See https://www.nerc.gov.ua/?id=24773.

[11] Eligible households are enrolled automatically for benefits on the basis of professional status, services rendered to the government, date of birth, or family status. There is no issue of self-selection into the benefits program. Within the allowance, the tariff is reduced by 20% to 75%, depending on professional or personal status.

receive cash: The subsidy amount was simply subtracted from the utility bill, thus reducing the balance due.

The HUS amount a household is entitled to is calculated using the following formula:[12]

(1) $$HUS = BSN - \left[\frac{Y}{min.subsistence\,income} \cdot \frac{1}{2}\right] \cdot 0.15 \cdot Y \cdot N\ ,$$

where BSN are the utility bills that would be paid if consumption was exactly equal to the social norms, Y is income per household member (in the previous six months), the minimum subsistence income is established by the government, and N is the number of household members. The social norms consumption is computed based on household size, type and size of dwelling, type of fuels used, and is regionally and seasonally adjusted, and does not depend on the household's current or historical consumption.[13] The HUS is then distributed across the utility bills—those for electricity, gas, district heating, water and sewage—in proportion to that bill's share of the total energy bills.

Despite the financial pressure created by the new tariffs and the HUS eligibility changes during our study period, observers generally point out that families kept up their payment compliance (Laderchi and Umapathi, 2017).[14] By 2017, almost half of the households in

[12] HUS beneficiaries are those households whose total housing and utility normative bill is above a threshold defined as (Y/SUBS)·br·k, where Y is total household income per household member, SUBS is subsistence level per household member (set by the government) as of the date when the subsidy is granted, br (=0.5) is base income ratio for the subsidy, and k (=.15) is the base rate for housing and utilities services. For instance, for a household with income that is just the same as the subsistence level, the threshold is 7.5%, which gets multiplied by total household income. Normative consumption is household-specific, and depends on the size of the home, on household size and on the type of equipment and heating fuel. For example, for a home that uses gas heat for the period after September 2014, the normative gas consumption was set as 23.6·hhsize + 11·min(21·hhsize, home area in m^2). The HUS payment is calculated as the difference between the total cost of normative consumption (i.e. the normative consumption for each type of utility, times the relevant tariff) and ((Y/SUBS)·br·k)·income). If the latter exceeds the former, as might be the case for a relatively high-income household, the household is not eligible for HUS support.
[13] The HUS would thus be the same for a conservation-minded and more wasteful household, as long as they live in similar dwellings and have the same composition and income.
[14] There appears to be much heterogeneity in the collection rates and arrears in the transition economies, both across countries and over time. Anex (2002, p. 404) reports that in 1997 collection rates for electricity were only 50% in the Russian Federation and Kazakhstan, about 70% in Armenia, and about 80% in Ukraine, but these figures appear

Ukraine had received HUS subsidies. Because eligibility is based on both expected consumption and income, HUS subsidies are by design more targeted than the implicit subsidies received by natural gas users when the tariffs were artificially kept below the price of gas on the international market, transmission through pipeline and distribution costs.

3. The Data

3.A. Construction of the Sample

We have five waves of Ukraine's Household Budget Survey (from 2014 to 2019). A summary of the sample size for each wave is displayed in table 1. The expenditure and income information is provided in each HBS data set for the full year, even though Ukrstat, the statistical service of Ukraine, collects the HBS information from each household on a quarterly basis. We appended the national as well as oblast-specific consumer price indices,[15] information about utility tariffs from NERC and Ukrstat, and oblast-specific heating and cooling degree days in each year, since the HBS does not indicate exactly in which city, town or village the household lives.

Heating and cooling degree days are important because the demand for heating and cooling, and the related fuels, depends crucially on outside temperature (Summerfield et al., 2015). Ukraine averages about 4,000 heating degree days a year (base: 18° C). The heating

to commingle industrial and residential customers. Dodonov et al. (2004) consider non-payment widespread and cite official estimates that households pay for only 70%-80% of the electricity they consume. Fankhauser et al. (2008) examine the "stock" and "flow" of arrears for all utilities in the various regions of Ukraine in 2003 and 2004. Fankhauser and Tepic (2007) report that "payment discipline" among residential customers has improved over recent years, and that "many countries now have collection rates close to 100%."

[15] We normalized the CPIs so that it is equal to 100 in 2014. With the national CPI, for example, 2014=100, 2015=148.7, 2016=169.4, 2017=193.8 and 2018=214.9.

degree days were practically the same in 2017 and in 2018, the two years that we examine in detail below.

In addition to documenting expenditures, income and government transfers, the HBS does contain information about housing tenure, the structural characteristics of dwelling, and some of the appliances therein. For example, we know if the home is served by piped natural gas (gascentr=1), district heating (heating=1), is equipped with a gas water heater (gaskol=1), or has an electric stove (elektrpl=1). The exact nature of the heating system however must be inferred. We assume that if the household has district heating (heating=1) but is also served by piped natural gas, then the latter is used for either cooking or for heating water (if gaskol=1), or both.

If a home is connected to the natural gas network and zero district heating expenditure is reported, then we assume natural gas is used for space heating, for heating water (unless gaskol=0), and for cooking (unless elektrpl=1). The data sets also specify whether the dwelling is on a centralized, or on a separate and independent, heating system.

3.B. Homes and Heating

Homeownership (92%) was stable over 2014-19, as were the shares of households living in single-family homes (52%), or in units in multi-family buildings (41%). The exact size of the dwelling is only available in the 2014 and 2016 HBS; Ukrainian families live in and must heat on average about 40 square meters. The shares of the samples served by the different types of fuels or heating are likewise very stable over the 6 years. About three-quarters of the sample are served by piped natural gas. About 31% of the households are served by district heating. About 45% of the sample uses piped natural gas for heating, 15% uses piped natural gas to feed its water heater, and only 5% uses electric cooking stoves.

3.C. Income and Government Assistance

The HBS shows that the total income of households—a measure that includes salaries, cash income, as well as in-kind payments, subsidies and benefits—declined dramatically from 2014 to 2016. It recovered somewhat in 2017, and further improved in 2018 and 2019 (Figure 1).

One key piece of information is the HUS amount and any other assistance with energy bills received by the household.[16] Table 2 displays the percent of the sample that received HUS assistance (col. (1)) or "benefits" due to their professional or protected category status in each year (col. (2)).[17] The table shows that the HUS was bumped up significantly in 2016, and that in 2016-2018 a good half of the households received it. By contrast, the share of the sample entitled

[16] The HUS reporting procedure changed somewhat over the different waves of the HBS. The 2014 and 2016 HBS, for example, provide detailed expenditure on each type of fuel (natural gas, liquified natural gas, solid fuels, heating oil) used in the home, district heating (if available), electricity, plus water and sewer, and the subsidies and "benefits" (i.e., "privileges") received for each such item. The 2015 data set provides only housing-related expenditure, a much broader category that includes the abovementioned utilities, rent, cleaning expenses, and garbage removal fees. The 2017 and 2018 HBSs contain expenditure on each energy input or utility at a good level of detail, but only the total HUS (the Housing and Utility Subsidy), without breaking it down by utility type.
To compute the exact HUS for each type of energy or utility, we follow the procedure of the Ukrainian government, which first computes the total HUS for a household based on the social norms and the household's income, and then distributes it among the various utilities in strict proportion to each utility bill's share out of total utility bills. This is done separately for the heating season (November-March), heating season shoulder months (April and October), and for the summer. We use the shares of the annual total bills to compute the portion of the HUS that applies to each utility. Since the share of the total utility bills accounted for by each of gas, electricity, water, sewer, and district heating is generally different across these the seasons, this is an approximate procedure. Simple calculations based on the examples provided by Ukrainian officials however suggest that this approximation yields figures that are very close to the true ones. For the 2017 and 2018 HBS, we proceed as follows. First, we compute what the total utility bills would have been, had there been no subsidies or benefits. Formally, full utility bills=$\sum_{j=1}^{K} Exp_j + HUS + Benefits$, where $\exp_j$ denotes the expenditure (what the household actually paid, after the subsidies or benefits were subtracted from the full utility bill) for utility j, and K is the total number of utilities. Next, focusing for example on those households that use piped natural gas, we recognize that gas bill=gas exp + HUSgas, and that HUSgas ≈(gas bill/full utility bills)·HUS, which means that gas bill = gas exp/(1-HUS/full utility bills). We do the analogous calculations for district heating bills, water bills, sewer bills, and the bills for other types of fuels. Once the full bills have been computed, we can attribute the HUS to utility j as HUS_j ≈ HUS·(bill for utility j/full utility bills).
[17] Households on so-called benefits because of professional or social status receive discounts on the full tariffs of the utility. These discounts usually range from 25% to even 100%. The HBS reports the total amount of the benefits received (i.e., the total amount discounted off the bills). We use this information to infer the discount rate itself. If p is the price per unit and q the quantity consumed (e.g., m^3 of natural gas), and d denotes the percent discount off the full tariff, then the payment will be $p\cdot(1-d)\cdot q$, and $p\cdot d\cdot q$ will be reported as the benefit. This allows us to compute an approximate benefit discount rate as Benefits Received/(Benefits Received + Utility Payments).

to "benefits" appears to have dwindled over time, possibly because by 2017 households were denied the chance to avail themselves of both HUS and "benefits," and were required to choose between them.

Table 3 compares the HUS amounts documented in the HBS for various types of households with official administrative data, suggesting that the figures in the HBS are generally in line with the official statistics. Table 4 displays the shares of the sample (or of specific segments of the sample) that receive the HUS—for natural gas and/or for other utilities—in each year. Table 4 broadly confirms the evidence in table 2, but also shows that users of natural gas are more likely to receive the HUS than the other households, and that up of two-thirds of the households that use natural gas for space heating report receiving the HUS.

Were the households that received the HUS poor? Table 5 shows that after 2014 HUS recipients were by no means limited to the poorest people, although the shares of HUS recipients are higher in the first three quintiles of the distribution of income. In 2017 and 2018, one-third of the households in the top income quintile received the HUS. Table 6 presents another striking piece of information. While in 2014 almost half of the HUS disbursements went to the households in the first quintile of the distribution of income, in 2016 and 2017 the HUS was handed out almost evenly to all income quintiles. This tendency was somewhat moderated in 2018 and 2019, when the wealthiest 20% of the households received only about 12% of HUS.

3.D. Natural Gas Usage

In the remainder of this paper, attention is restricted to those households in the HBS that use natural gas (about three-quarters of the full HBS sample), and more specifically to those that use piped natural gas for space heating (48% of the full HBS sample). Fully 80% of the latter use their own individual heating system (as opposed to one in common with the rest of the building). About 58% of those who use gas for space heating live in single-family homes, 20.7% live in apartments in multi-family buildings, and 21.6% has other living arrangements.

For 2017 and 2018, we can compute the quantity of piped natural gas consumed during the year from the expenditure on gas (and the gas HUS, if received by the household) reported in the HBS, because by 2017 the block tariff system had been removed and the gas tariffs were stable in 2017 and 2018. Table 7 summarizes the annual gas consumption levels in 2017 and 2018. They were similar, in part because the price of gas was essentially unchanged over two years and in part because the weather was very similar in those two years (bottom panel of table 7). The average household uses about 800 cubic meters of natural gas a year.

Figure 2 presents the distribution of gas consumption in 2017 and 2018 combined for households who use gas for space heating, distinguishing for households that did and did not receive HUS assistance. This figure conveys an important piece of information: The distribution of gas consumption for HUS recipients is to the right of that for the other households. In other words, HUS recipients tend to consume more gas. This raises the question whether HUS recipients get HUS assistance *because* they consume more, or increase consumption *because* they receive assistance, or do a little bit of both.

Table 8 begins to examine this question by displaying the frequencies of households that fall in each quartile of the distribution of (net) income and each quartile of the distribution of gas consumption. This table shows how surprisingly evenly distributed households are in terms of income and consumption: The poorest families (those in the first income quartile) are certainly not exclusively concentrated in the first or second consumption quartile, and the richest families (those in the fourth income quartile) are certainly well represented even in the lowest consumption quartiles. The households in the second and third income quartiles are almost perfectly evenly distributed among the four consumption quartiles. This is a first hint at the fact that the relationship between income and gas consumption is a relatively loose one.[18]

HUS recipients among those households that use natural gas for space heating received on average 4,558 UAH (2014 UAH) a year in 2017 and 2018—or 17% of pre-HUS income. The gas HUS was on average 2,563 UAH a year during that period, or 9.76% of net income. These figures confirm that the HUS was a generous program, and also point to the difficulty of sustaining such payments over a long time on the part of the Ukrainian government.

Finally, table 9 presents the percentage of households in each income-gas consumption quartile that receive the HUS. The HUS is almost ubiquitous among heavy gas users, but also quite common even among the better-off households (top quartile of the distribution of income).

4. Methods

We document the effect of the natural gas tariffs reforms of 2015 and 2016, and assess the effects of the HUS, using three main metrics. First, we examine the bills as share of household income or expenditure before and after the tariff hikes, with and without the HUS. Second, based on such shares, we examine the fraction of the population that experiences fuel poverty, in that energy and fuel bills exceed 10% of income. Third, we compute the consumer surplus change attributable to the HUS itself—under the actual implementation of the program, and under hypothetical variants of it meant to target primarily low-income households.

To further elaborate on the latter point, we ask how the consumer surplus would change if the current HUS was altogether removed, halved, or replaced by a HUS program linked more

[18] That the correlation between energy use and income is not very strong has been observed in studies examining the incidence of electricity bill and the redistributive role of tariffs (e.g., Levinson and Silva, 2019).

tightly to income and decoupled from fuel consumption. The welfare gains attributable to the HUS are thus the same, but opposite in sign, as those of removing it entirely. One key feature in common to the three metrics is that we examine their distribution across income quartile-gas consumption quartile cells.

For simplicity and due of data limitations, attention is restricted to those households that use natural gas for space heating (some 58% of all HBS households), to the gas HUS, and to the data from 2017 and 2018, when a one-part tariff with constant price per unit of gas was in place, and the price was virtually constant over time, which allows us to compute quantity demanded from the expenditure and HUS data reported in the HBS.

In order to compute the consumer surplus, we must first estimate a demand function. Ideally, we wish to estimate

(2) $$ln\, Q_i = \alpha + \beta \cdot ln\, P_i + \gamma \cdot ln\, hinc_i + \mathbf{x}_i \boldsymbol{\delta} + \varepsilon_i$$

where Q is gas consumed during the year, P is the price of natural gas, hinc is household income, **x** is a vector of dwelling, household and location characteristics, and β and γ are the price and income elasticities of demand, respectively. However, the tariffs were stable over 2017 and 2018, and the share of households who received "privileges" (and hence discounted gas tariffs) during those years is only 6-7%, which means that we lack the variation necessary to fit demand function (1) (see bottom row of table 10). We get around this problem using two possible approaches.

Approach 1 assumes that the gas HUS acts as a price subsidy. Under this assumption, the price per cubic meter of gas effectively paid by the household is $P_i^* = \frac{(P_i \cdot Q_i - gasHUS)}{Q_i}$, where P is the posted price or the discounted posted price if the household is entitled to privileges. Clearly, P_i^* is equal to P_i when the household does not receive the HUS, and it will be lower than otherwise. As shown in Figure 3 and in the first row of table 10, P_i^* displays considerable variation, allowing us to estimate a proper demand function. After obtaining the parameters in (2), the consumer surplus lost if the HUS removed is the consumer surplus loss when prices go from P_i^* to P_i.

Alternatively, the HUS can be thought of as a demand shifter. The price elasticity of demand cannot be estimated due to insufficient variation in prices, but we can constrain it to be equal to a plausible value, $\bar{\beta}$, and amend equation (2) to:

(3) $$(ln\,Q_i - \bar{\beta} \cdot ln\,P_i) = \alpha' + \gamma' \cdot ln\,hinc_i + \mathbf{x}_i \boldsymbol{\delta}' + \lambda \cdot lnGasHUS_i + \varepsilon_i.$$

Note that in equation (3) the log of the gas HUS enters as a separate regressors, and not as part of income, since the gas HUS can only be applied to the gas bill and is not cash that can be spent on anything else—at least not during our study period.[19] In other words, we have no reason to believe that households would consider the gas HUS as additional income. If this approach is adopted, then the change in consumer surplus is simply the difference between the consumer surpluses with and without the HUS. In what follows, we set $\bar{\beta}$=-0.16, the price elasticity of demand in Alberini et al. (2020) based on gas-using households in Uzhhorod in Western Ukraine. In addition to OLS, equation (3) lends itself to quantile regressions to examine whether λ is different for light and heavy users of gas.

5. Results

5.A. Effect of HUS on Energy Expenditure Burden

[19] In May 2019, the HUS was monetized, i.e., it became a cash payment and was no longer directly applied to the bills. Unfortunately, we only have annual expenditures, income and HUS for 2019, and the quality of the 2019 HBS is doubtful, which means that we are unable to assess the effect of the monetization using the HBS data.

Table 11, col. (1), shows that for households that use natural gas for space heating, the full gas bill accounts for a large portion—more than half—of the total energy and fuel bills. Col. (2) presents the energy and utility costs (after the HUS) as shares of net income for the subset of these households that did not receive HUS assistance, and col. (3) presents the same information for those that do receive the HUS.[20] While the shares were similar across the two groups in 2014, prior to the tariff hike, they were 5 percentage points apart thereafter, although by 2018 the difference seems to have shrunk somewhat.

Shares of energy costs (natural gas, electricity and other fuels) between 6 and 11% of net income are fairly large when compared with other expenditure categories. Between 2014 and 2018, Ukrainian households spent on average 42%-45% of net income (54%-57% of total consumption expenditures) on food, and about 4%-5% of net income (5.7%-7% of consumption expenditures) on their own health. It is noteworthy that in 2016-2018 the average share for non-HUS households is stable at 11%. In other words, the average household that does not receive HUS assistance would still be classified as energy poor by conventional standards.

Table 12 presents the average electricity, gas and fuel shares of net income among households that use natural gas for space heating, separately for households that do and do not receive the HUS, and by income-gas consumption quartile, showing that the shares are considerably lower among HUS recipients, especially for families in the first and second income quartiles. The contrast between panels A and B is especially stark for heavy gas users.

Table 13, panel A, shows the percentages of the households in each income-gas consumption quartile cell that are classified as "fuel poor" (with electricity and domestic fuels bills in excess of 10% of income), or would be, had they not received the HUS. Clearly, the

[20] Net income is household income minus the HUS (which Ukrstat adds to the other sources of income to compute total household income).

percentages are highest at the lowest levels of income and among the heaviest gas users. What is striking is that in half of the income-usage cells virtually everyone would be classified as fuel poor. Panel B presents the same shares once the HUS is received. In the first quartile of the distribution of income, for example, the HUS reduced the rate of fuel poverty by half. Massive improvements are also observed in the top income quartile, especially at high consumption levels.

Table 14 displays fuel poverty over time—without and with the HUS. Clearly, the HUS reduces fuel poverty by half. Yet, a good one-third of the households in Ukraine meets the definition of fuel poor, even when the HUS is in place.

5.B. Estimating Demand

What would be the welfare effects of removing the HUS completely? We answer this question using two possible approaches. The first fits a gas demand function to households that use gas for space heating, assuming that the HUS serves as a subsidy on the price of gas per cubic meter. As shown in table 10 and figure 3, treating the HUS as a price subsidy increases substantially the variation in the effective price of gas, making it possible to fit a proper demand function.

The estimation results are displayed in col. (1) of table A.1. in the Appendix.[21] They show that the price elasticity of residential gas demand is -0.17, a figure that is very close to that (approximately -0.16) in Alberini et al. (2020) based on a sample from Transcarpathia. The

[21] We remind the reader that the sample used for the regression of Appendix A includes only the HBS households that use natural gas for space heating, and only the 2017 and 2018 HBS data. This is because the one-part tariff with stable, uniform prices make it possible for us to compute the quantity consumed from the expenditure and HUS information. The tariff structure remained in place in 2019, but we are not satisfied with the quality of the data from the 2019 HBS at our disposal (the first release by Ukrstat), and for this reason we do not include the 2019 HBS data in our estimation effort.

regression also shows that, controlling for oblast-specific fixed effects, other factors matter, such as the type and size of the home, and the gas-using equipment used in the home. The log transformation of heating degree days—generally held to be an important determinant of gas demand—does not enter significantly. We attribute this result to the presence of the oblast-specific fixed effects. The income elasticity is positive and significant, and equal to about 0.28.

The second approach (described by equation (3)) assumes a price elasticity of -0.16, and regards the HUS as a demand shifter. Col. (2) in table A.1 in the Appendix reports the estimation results. The gas demand elasticity with respect to the gas HUS is 0.079. For comparison, the income elasticity is 0.33. That the elasticity of demand with respect to the gas HUS is low means that we should expect only modest increases in consumption when a household receives the HUS and modest cuts in consumption if the HUS is removed or reduced.

Figure 4 displays heterogeneity in the response to the gas HUS as evidenced in the quantile regressions, showing that the elasticity with respect to the gas HUS tends to be more pronounced at low gas consumption levels, and declines as gas consumption increases.[22] We interpret this to mean that the HUS has helped light consumers increase their consumption, and that its effect has been more modest on heavy users.

5.C. The Effects of Removing the HUS

The HUS played a substantial welfare improving role by significantly reducing the energy expenditure burden. Based on the demand function in col. (1) of table A.1 in the Appendix, where we regard the HUS as a reduction in the price per cubic meter of gas, we compute that if the HUS were removed from its recipients, they would experience an average

[22] Figure 4 is created by modifying equation (3) to make it a quantile regression and estimating it for all quantiles between the 5^{th} and 95^{th} percentiles.

consumer surplus loss of 1,772.44 UAH (2014 UAH) per year per household. Expressed as a share of net income, the household consumer surplus loss is on average 6.46% of net income.[23]

Table 15 summarizes the loss of consumer surplus from removing the HUS by income and gas consumption quartile, which can be interpreted as the welfare gain brought by the HUS itself. The table shows that the *absolute* CS surplus gain is similar in magnitude across income and consumption quartiles, and significant for the relatively well-to-do households in income quartiles 3 and 4.[24] This indicates that there is room for improvement in targeting the assistance to the neediest households. The top 50% income households experience a larger CS gain from the HUS than poor households in 1st and 2nd consumption quartile, and as large a gain as poor households in the 3rd and 4th consumption quartile. Panel B of the table shows that those in the first income quartile gained the most, and would stand to lose the most if the HUS was removed, in relative terms, with CS gains representing up to 14% of income. By contrast, the CS gain as a share of income is less than 3% for those in the top income quartile.

Using the estimated price elasticity of demand from col. (2) of table A.1 in the Appendix (about -0.17), we can also compute the change in the share of household expenditure brought by the elimination of the HUS. This is equal to the budget share, times (1-budget share), times the percentage increase in prices, times (1+the price elasticity) (Freund and Wallich, 1995). As show in table 16, the elimination of the HUS is predicted to increase gas expenditure as a share of total household expenditure from 4%-5% to about 10%. This reinforces the evidence shown in table 11.

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[23] These figures refer to HUS recipients whose HUS assistance would be eliminated. The overall consumer surplus loss—based on averaging these households with non-recipients who would therefore stand to lose zero—is 1,196.04 UAH (2014 UAH) or 4.36% of net income.
[24] The figures in the table show that for each income group the CS gains brought by the HUS grow slowly with consumption volume. Holding consumption volume the same, the CS gains change little from one income group to the next.

Table 17 summarizes the welfare effects of removing the HUS inferred from the "HUS as a demand shifter approach" and using the OLS estimates of the second column in table A.1 in the Appendix. The average loss of consumer surplus is 2,163 UAH (2014 UAH), or about 7.20% of net income, and is thus a bit larger than that computed in section 5.B.[25] The elasticity of gas demand with respect to the HUS implies that removing the HUS entirely would result in an 8% reduction in consumption. The CS loss (or the gains from the HUS) increases rapidly as we move from one consumption quartile to the next within a given income quartile.

Using the same approach, we compute that if the HUS were halved, the average CS loss would be 254.58 UAH per household per year, which is modest when compared with the CS loss from the full removal of the HUS and accounts for less than 1% of net income. Even among the poorest households, the CS loss is only around 1% of income (table 18). That the losses are modest follows from the fact that the elasticity of gas consumption with respect to the HUS is only about 0.08. The 50% change in the HUS would only shift demand by 4%, resulting in a small change in the CS. In absolute terms, the CS loss doubles as we move from the lightest to the heaviest consumers within each income quartile.

5.D. Alternate HUS Designs

What would happen if the HUS were replaced by an assistance system that is more targeted towards the poorest families and is decoupled from consumption? Suppose for example households below the poverty line received a subsidy equal to the difference between the poverty

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[25] The unconditional mean loss of consumer surplus for the entire sample, inclusive of households who experience zero loss because they do not receive HUS assistance, is 1,384.51 UAH (2014 UAH). The average share of net income is 4.60%.

line income and their income.[26] Who would gain/lose from such a subsidy design, and how much?

Table 19 summarizes the results from this exercise. There are a total of four groups of households. The first does not receive the HUS at present, nor does it receive the redesigned version. The loss of surplus for these households would be zero. Then there are households that do not currently get the HUS, but would under the new proposal. This group represents only 3.50% of the households, and would stand to gain from the proposed overhaul of the HUS (on average 1,769 UAH per household per year, in 2014 UAH). The next group (more than half of the sample) loses the HUS under the new proposal, losing on average 2,240 UAH (2014 UAH) per year. Finally, about 10% of the sample would continue to receive the HUS, although the new amount may well differ from the original one. Indeed this group includes just as many losers as it does winners, for an average CS change of -4 UAH (2014 UAH). Overall, the proposed subsidy design brings a loss of CS in the amount of 1,140 UAH per household per year. When attention is restricted to previous HUS holders, the CS loss is 1,689 UAH per household per year (2014 UAH).

Table 20 examines the impact of the redesigned HUS by income and consumption quartile. Each cell represents an income-consumption quartile pair, and the panels on the left of the table display how the households that belong to one such pair would be distributed among the four groups listed in table 19. Hence, the percentages in a given cell (e.g., the one for first quartile of income and first quartile of consumption) sum to 100% across the four panels. People

[26] The poverty line is 1,795.6 UAH monthly per adult-equivalent in 2016, 2,128.597 in 2017, and 2,325.0 UAH in 2018. One adult-equivalent is 1+0.7×(household size - 1). The statutory subsistence minimum (SM) is the official poverty line used in Ukraine. Households with per capita incomes below the statutory SM are considered poor and are eligible for a variety of social assistance programs. The statutory SM is a policy tool set by the Council of Ministers. See http://www.ukrstat.gov.ua/, tabs "Statistical Information," "Income and living conditions," "Differentiation of household living standards."

in the first income quartile and the first consumption quartile, for example, are distributed reasonably evenly across the four groups. Families in the fourth income quartile and the fourth consumption quartile are split 40%-60% between never-recipients and no-longer-eligibles. The panels on the right show that among new recipients (second group from top) the CS gains are larger among the heavier users within a given income quartile. Among still-recipients we observe the opposite effect.

Suppose now that households below 150% of the poverty line received a HUS equal to the difference between their income and 150% of the poverty line. As shown in table 21, this more generous design would reduce the number of households that lose their HUS subsidies, and would increase the number of winners. The overall effect would still be a CS loss (average per household -322 UAH per year; average for previous HUS holders, -422 UAH per household per year). Table 22 shows that the CS changes are similar for sign and magnitude to those in table 18.

An even more generous variant of this proposal (200% of the poverty line) would attain an overall CS gain of 519 UAH per household per year (613 UAH among those on the current version of the HUS) (table 23). Table 24 displays the gains (generally larger than those in table 21) and losses (likewise, but for a smaller share of the sample) from this version of the HUS.

6. Discussion and Conclusions

The residential energy assistance program in Ukraine—the HUS—is unique and provides interesting insights. Its formula combines two targeting elements not typically applied together to assess the energy burden, first an element of income means-testing, and second, the expected volume of energy consumption. The latter is based on household size, dwelling type, and size, and is regionally and seasonally adjusted, but—unlike others, such as the one in Argentina documented in Bastos et al. (2015)—*not* on historical or current actual consumption. Since the calculation of the HUS neither penalizes nor rewards heavier or lighter users, we do not expect it to engender incentives to either over- or under consume.

We have examined the effects of the HUS on fuel poverty and on consumer welfare, finding that it has significantly ameliorated the fuel poverty situation of its recipients, and brought considerable gains in consumer surplus for its recipients. We have used two alternate approaches to incorporate the gas HUS into the household demand for natural gas. The first simply posits that the HUS has changed the effective price per unit of natural gas, finding that the price elasticity of demand is -0.17. The second treats the HUS as a shifter of the demand function and constrains the price elasticity to be -0.16, a figure from an earlier study in Ukraine (see Alberini et al., 2020) that is almost identical to that estimated using the first approach. Demand is thus relatively price-inelastic and increases only modestly with the HUS. The consumer surplus gains brought by the HUS are 6%-7% of net income.

While the HUS appears to have been greatly beneficial to its recipients, it does drain the state coffers. It accounts for 1%-2.5% of GDP (2016-2020). In part, the high cost is due to atypically high level of HUS coverage and considerable share of the benefit going to the relatively rich groups. The inclusive nature of the HUS was warranted for political economy reasons to prevent backlash and policy reversal, with eligibility tightened after the initial expansion of the assistance, which brought HUS costs down from 2.15% in 2017 to under 1% of GDP in 2020.

Table 25 summarizes the HUS disbursements received by households who use natural gas for space heating under the current HUS and each of the five hypothetical scenarios considered in this paper. A result that suggests potential for cost-benefit optimization is that cutting the HUS subsidies in half would entail a very small loss of welfare for consumers with respect the full HUS subsidies.

Additional alternative scenarios for energy assistance include combining one of the five hypothetical scenarios of table 25, all of which are associated with a negative average consumer surplus change, with other schemes, like social tariffs. To illustrate, we calculate that if households in the bottom income quartile were charged 80% of the regular tariff, and those in the top income quartile were charged 1.15% of the regular tariff, the former would experience a modest CS gain (437.15 2014 UAH), and the latter would experience a modest CS loss (487.25 2014 UAH), at no loss of revenue for the utility. The low-price elasticity of demand implies that consumption would not decrease in the high-income groups, or increase in the low-income groups, to the point of compromising this self-sustaining scheme. The social tariff scheme could thus be used to ameliorate the effects of a HUS overhaul, at least among the poorest households.

One related and important issue is that Ukraine is a highly energy-inefficient country and has CO_2 emissions per unit of GDP far higher than the European Union average. As the economy continues to grow and the country strengthens its relationship with Europe, we would expect that some emphasis will be placed on reducing CO_2 emissions from buildings, especially residential buildings (McKinsey and Company, 2009). While in other countries consideration is being given to electrifying heat—in the expectation of transition to a low- or no-carbon electricity supply[27]—it seems likely that space heating in Ukraine will continue to rely on natural gas (and on district heating powered by natural gas) in the near future. Energy efficiency, however, could be

[27] See https://innovationweek.irena.org/-/media/Files/IRENA/Innovation-Week/SessionalDocuments/Summary/IRENA-IW2018-Session-Summary---Electrification-of-Heat.pdf and https://eciu.net/analysis/briefings/low-carbon-heat/the-electrification-of-heat, for examples from the U.K.

substantially improved in homes and multi-family buildings, for potential savings of up to 50% of the current usage of natural gas (IFC, 2017; Emerson and Shimkin, 2015).[28] Furthermore, without substantial improvements in energy efficiency, affordability will continue to be a critical issue, especially for low-income households. There is a substantial share of high-volume, low-income consumers who experience severe fuel poverty despite the HUS assistance. Our quantile regressions show that low volume consumers are more elastic to HUS support, and high volume are less elastic, which suggests potential efficiency gains by targeting high-volume, low-income consumers with energy efficiency measures. However, — research on the cost-effectiveness of such an approach is lacking in transition economies.

A number of programs in Ukraine help finance energy efficiency upgrades in buildings (both privately and government-owned) and modernize infrastructure. The two that most directly affect homeowners are the Warm Loans program (which started in 2014) and the Energy Efficiency Fund (which started in 2019 and targets primarily homeowners' associations in multi-family buildings). Under the Warm Loans program, individual homeowners obtain loans to pay for certain types of energy efficiency upgrades. The government reimburses the homeowners up to 35% of the principal of the loan (20% if for a boiler, but 35% if the homeowner has received the HUS), up to a certain cap. The loan is provided by selected banks, with interest rates that have ranged historically between 18% and 27%. About 850,000 households—some 5.7% of the total number of households in Ukraine—have availed themselves of this program since its inception, receiving reimbursements from the government for about 3.3 billion UAH. The average cost of a project for individual homeowners is about 18,000 UAH.[29]

[28] Estimates by the Ministry for Regional Development indicate that renovating multi-family buildings and single-family homes, and replacing individual gas boilers with more efficient ones, has the potential to save some 8.7 billion cubic meters of gas (IFC, 2017, page 9).
[29] Over two-thirds of the funding to individual homeowners covered window replacement (IFC, 2017).

Based on government reports (2016, 2017) and Alberini et al. (2019), it reasonable to assume that energy efficiency improvements reduce gas consumption by some 20% on average. For a home improvement project costing 18,000 UAH, a household that seeks to borrow half of that amount would be receiving 3150 UAH from the government. Excluding interest payments, this would bring the cost of the project to 14,850 UAH, which would be easily “paid back” by the savings on the gas bill over the lifetime of the equipment and materials (20 years) at no loss of welfare for the household.[30]

It should be noted that the 3,150 UAH payment from the government would be a one-time payment that is just about equal to or less than the average annual HUS payment during 2018 (4,800 for the full HUS on all utilities, and 2,949 UAH for the gas HUS), but that it helps secure gas consumption reductions over many years. The approximate cost to the government per year would be, if it continued at the same rate as in the past, some 400 million UAH for a saving of 800 $\times 0.20 \times 14{,}934{,}919$ households$\times 0.08$ (the share of households participating in a year)=19,117 million cubic meters of gas per year. The program budget has been, and would continue to be, a fraction of that for the HUS.[31]

[30] The household would demand less gas but be equally or more comfortable in a better insulated, and warmer, home. The low-price elasticity of gas demand ensures that any “rebound effect” would be negligible (Sorrell et al., 2009).

[31] Unfortunately, the 2021 budget for the Warm Loans program is only 150 million UAH, much less than the 400 million UAH in each of 2018, 2019 and 2020.

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Figure 1. Total annual household income (inclusive of government assistance and HUS), 2014 UAH.

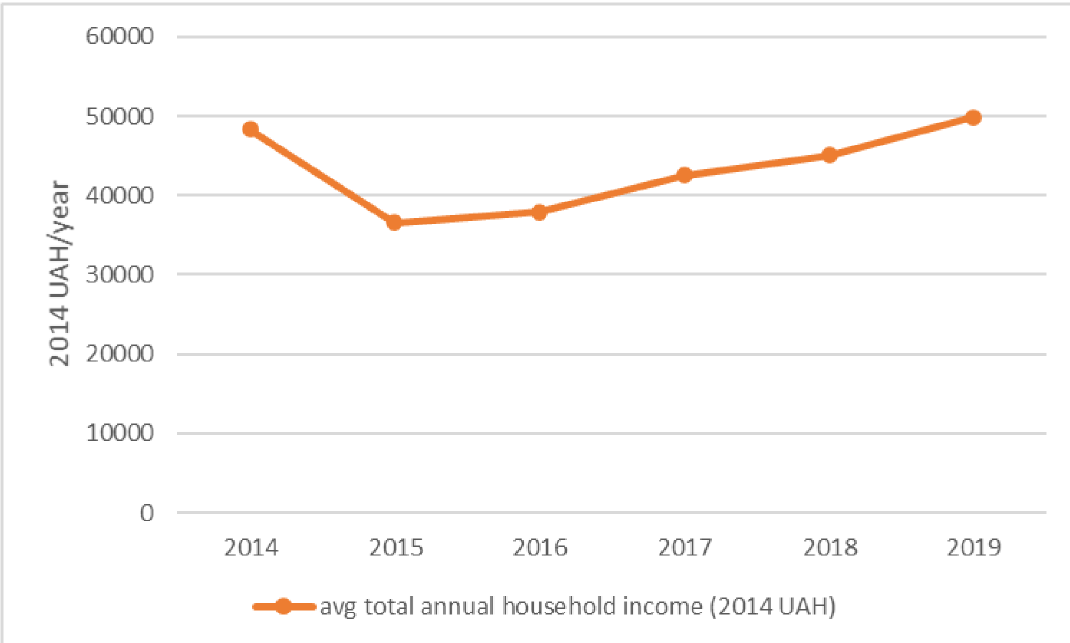

Figure 2. Annual gas consumption for households on gas heat, 2017-2018.

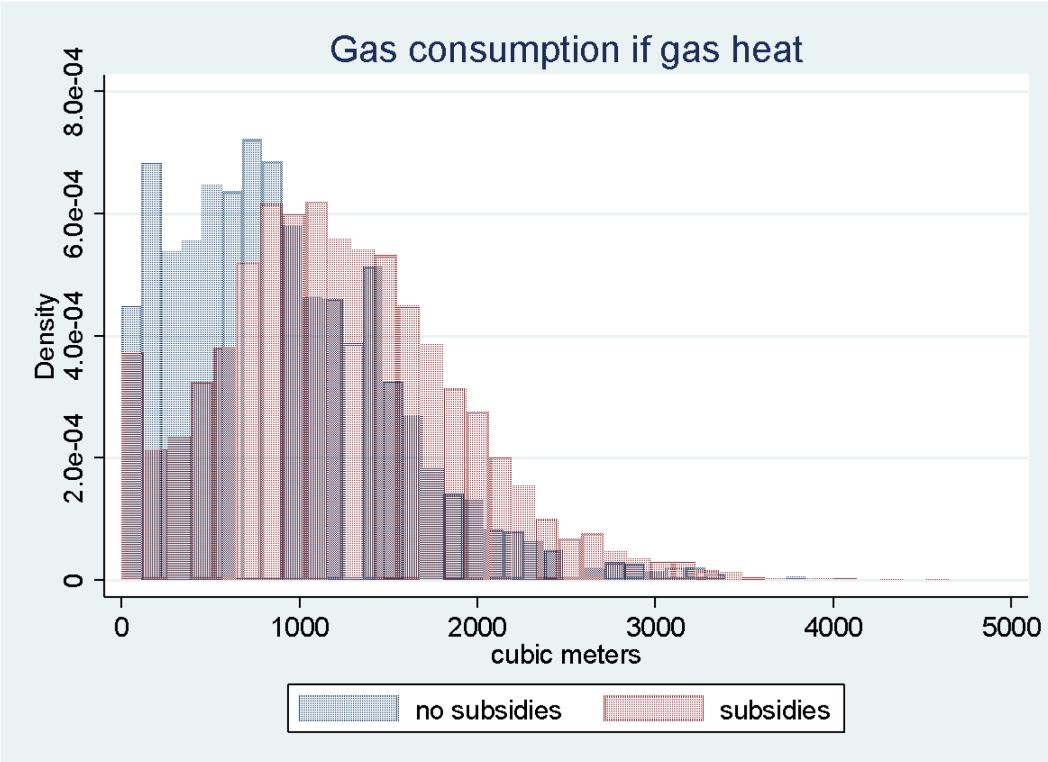

Figure 3. Implicit price per cubic meter of gas when the HUS is applied, 2017-18, nominal UAH.

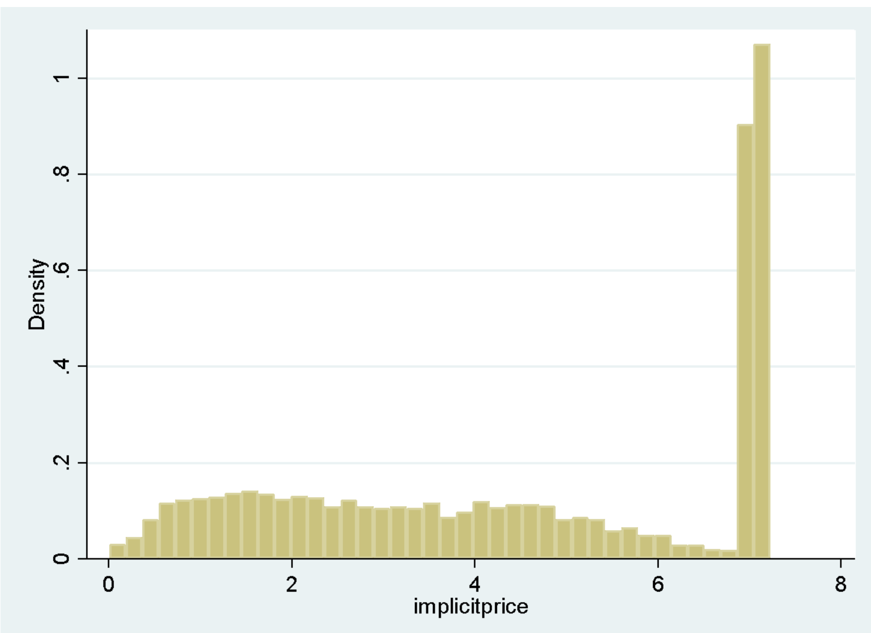

Figure 4. Coefficients on log HUS for gas from quantile regressions.

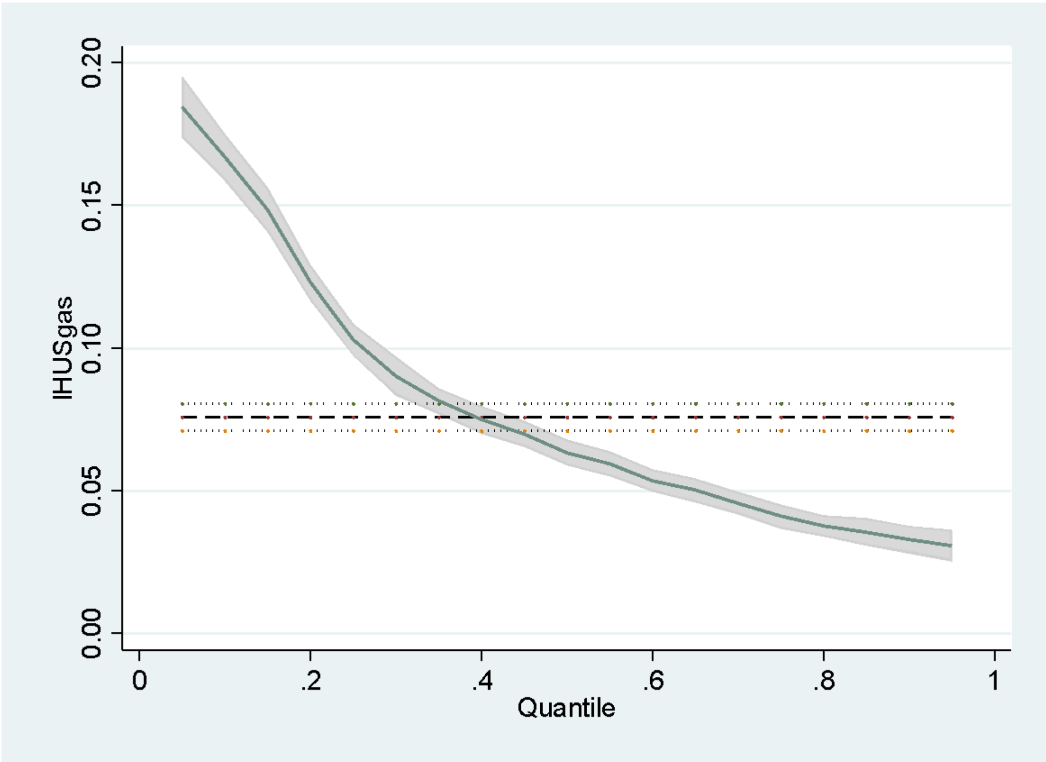

Table 1. Observations available in the Ukraine HBS.

Year	Number of obs.
2014	8,814
2015	9,097
2016	8,168
2017	7,958
2018	8,051
2019	8,107
Total	50,195

Table 2. Percent of the HBS sample receiving the HUS or benefits (also termed privileges, namely discounted tariffs due to professional status or protected category). Source: HBS, all households.

Year	Share of the households receiving HUS	Share of the households receiving Benefits (=privileges)
2014	5.15%	21.44%
2015	22.39%	n/a
2016	47.30%	12.46%
2017	51.95%	7.07%
2018	49.36%	5.96%
2019	33.00%	n/a

Table 3. HUS documented in the HBS and Ukraine government administrative data: Annual average HUS per household (nom. UAH).

Year	HBS: HUS (any type)	HBS: HUS (any type) if district heating	HBS: HUS (any type) if gas heat	HBS: HUS for gas if gas heat	HUS as per Ukrstat
2014	974.97	1,167.5	937.01	792.52	1,397.93
2015	2,861.4	n/a	n/a	n/a	2,761.76
2016	7,570.63	5,536.04	9,477.37	7,675.99	5,728.48
2017	8,863.46	7,780.16	10,424.3	5,666.22	9,091.76
2018	6,895.99	6,534.18	7,963.5	4,708.95	7,762.34
2019	7,226.17	7,354.84	6,845.04	n/a	5,168.76

Table 4. Share of households that receive any type of HUS or the gas HUS by year.

Year	(A) Receive the HUS	(B) Receive the HUS (among natural gas users, incl. district heating users)	(C) Receive the HUS for natural gas (among natural gas users, incl. district heating users)	(D) Receive the HUS (among users of natural gas for space heating)	(E) Receive the HUS for natural gas (among users of natural gas for space heating)
2014	5.15%	5.64%	5.59%	5.44%	5.37%
2015	22.39%	n/a	n/a	n/a	n/a
2016	47.31%	53.86%	51.49%	60.11%	56.97%
2017	51.95%	60.44%	57.37%	66.14%	62.54%
2018	49.36%	56.98%	55.61%	62.66%	61.23%

Table 5. Percentage of households that receive the HUS in each quintile of the distribution of income. Source: HBS, all households.

Year	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile
2014	12.71%	6.64%	4.25%	1.36%	0.79%
2015	n/a	n/a	n/a	n/a	n/a
2016	59.18%	54.16%	48.74%	41.06%	33.37%
2017	64.01%	59.61%	50.91%	48.18%	37.02%
2018	66.05%	56.83%	49.50%	41.49%	32.92%
2019	51.39%	40.77%	30.84%	22.85%	18.97%

Table 6. Percentage of the total HUS paid each year that was received in each quantile of the distribution of income for that year. Source: HBS, all households.

Year	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile
2014	48.35%	26.26%	17.86%	4.49%	3.04%
2016	21.39%	21.34%	20.89%	19.06%	17.33%
2017	23.21%	22.00%	19.90%	18.88%	16.02%
2018	28.19%	23.77%	19.81%	16.29%	11.94%
2019	30.67%	24.75%	18.23%	13.53%	12.45%

Table 7. Annual Consumption of natural gas (in m^3) and heating degree days (base: 18° C) in 2017 and 2018.

Consumption of natural gas in m3					
Year	**Mean**	**p25**	**p50**	**p75**	**p90**
2017	798.57	172.03	605.02	1,262.28	1,816.02
2018	797.87	171.21	668.56	1,259.90	1,751.37
HDD					
Year	**Mean**	**p25**	**p50**	**p75**	**p90**
2017	3,703.79	3,596.01	3,812.57	3,848.67	4,082.94
2018	3,702.23	3,607.78	3,713.49	3,886.54	4,023.68

Table 8. Relationship between income and gas consumption for households that use gas for space heating (gasheat=1). Source: HBS, 2017-2018.

	Consumption quartile of gas consumption (2017 and 2018)				
Income quartile	**1**	**2**	**3**	**4**	**Total**
	782	769	730	531	2,812
1	27.81	27.35	25.96	18.88	100.00
	27.84	27.38	25.99	18.90	25.03
	723	720	767	665	2,875
2	25.15	25.04	26.68	23.13	100.00
	25.74	25.63	27.31	23.67	25.59
	678	678	693	746	2,795
3	24.26	24.26	24.79	26.69	100.00
	24.14	24.14	24.67	26.56	24.88
	626	642	619	867	2,754
4	22.73	23.31	22.48	31.48	100.00
	22.29	22.86	22.04	30.87	24.51
	2,809	2,809	2,809	2,809	11,236
Total	25.00	25.00	25.00	25.00	100.00
	100.00	100.00	100.00	100.00	100.00

Table 9. Percentage of households using natural gas for space heating in 2017-2018 that receive the gas HUS or any other HUS.

	Consumption quartile			
Income quartile	**1**	**2**	**3**	**4**
1	45.59%	60.40%	82.60%	93.06%
2	37.62%	40.23%	68.27%	83.51%
3	32.58%	42.90%	61,15%	72.73%
4	0.25%	39.17%	45.14%	60.02%

Table 10. Implicit and nominal gas price (UAH)

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Implicit price of gas	11,236	4.4641	2.3756	0.0027	7.2232
Gas price	11,843	6.9654	0.5327	3.4691	7.2232

Table 11. Electricity, natural gas and fuel costs for households who use natural gas for space heating (gasheat=1).

	Full gas bill as share of all full utility bills (average)	Electricity, gas and fuels expenditure as share of net income (H045/net income) for households that do not receive the HUS	Electricity, gas and fuels expenditure as share of net income (H045/net income) for households that receive the HUS
2014	64.46%	5.67%	5.91%
2016	71.88%	11.39%	6.15%
2017	56.14%	11.18%	6.70%
2018	58.57%	11.11%	8.08%

Notes: 1) For household that do not receive the HUS, the expenditures are equal to the full bills. For households that do receive the HUS, the expenditures are the full bills minus the HUS. 2) Net income is defined as total income (as reported in the HBS) minus the HUS. 3) Utility bills include electricity, gas, district heating, water, sewage, propane/liquid and solid fuels. 4) The expenditures are net of the HUS, if the household receives the HUS.

Table 12. Energy (gas and electricity) expenditure as a share of net income by income quartile-gas consumption quartile. Households that use natural gas for space heating, 2017-2018.

A. Households that do not receive any HUS.

	Consumption quartile			
Income quartile	**1**	**2**	**3**	**4**
1	10.13%	15.41%	22.07%	30.86%
2	8.21%	9.86%	14.48%	23.84%
3	5.96%	6.79%	9.27%	16.12%
4	4.20%	4.92%	6.27%	9.88%

B. Households that receive the HUS (for gas or other utilities).

	Consumption quartile			
Income quartile	**1**	**2**	**3**	**4**
1	5.87%	8.00%	9.10%	10.55%
2	4.04%	5.87%	7.34%	9.12%
3	3.56%	4.90%	5.95%	8.39%
4	4.53%	3.97%	4.57%	6.80%

Table 13. Fuel poverty, households that use gas for space heating, 2017-2018.

A. Percentage of households that would be fuel poor if they had to pay the full electricity and gas bill. A household is considered fuel poor if the share of full electricity and gas bills out of net income is 10% or greater.

	Consumption quartile			
Income quartile	**1**	**2**	**3**	**4**
1	79.23%	100	100	100
2	51.06%	91.03	98.89	100
3	27.99%	46.70	90.34	99.15
4	12.84%	12.80	30.47	72.41

B. Percentage of households in actual fuel poverty. A household is considered fuel poor if its actual expenditure on electricity and gas (net of the HUS) is 10% or more of net income.

	Consumption quartile			
Income quartile	**1**	**2**	**3**	**4**
1	41.17%	50.50%	44.82%	44.64%
2	23.94%	41.60%	46.70%	46.65%
3	11.48%	13.44%	40.13%	51.91%
4	5.19%	3.20%	10.83%	32.10%

Table 14. Fuel poverty rates over time.

	Rate of fuel poverty if households had to pay the full electricity and gas bills	**Actual rate of fuel poverty**
2014	29.19%	13.67%
2016	73.76%	32.81%
2017	67.81%	31.25%
2018	62.27%	34.24%

Table 15. Loss of consumer surplus if the HUS was removed entirely. Approach based on regarding the HUS as an implicit price subsidy.

A. loss of CS (conditional mean among HUS recipients), 2014 UAH.

	Consumption quartile			
Income quartile	**1**	**2**	**3**	**4**
1	1,445.19	1,498.69	1,723.25	2,187.29
2	1,657.86	1,732.40	1,714.52	2,152.53
3	1,995.67	1,702.14	1,730.79	2,004.77
4	1,946.20	1,900.17	1,732.74	1,957.32

B. loss of CS as share of income (conditional among HUS recipients)

	Consumption quartile			
Income quartile	**1**	**2**	**3**	**4**
1	9.37%	9.99%	11.21%	14.11%
2	5.69%	6.10%	6.01%	7.46%
3	4.71%	3.82%	3.91%	4.47%
4	2.76%	2.66%	2.41%	2.65%

Table 16. Gas expenditure as share of total expenditures when the HUS is present and its change when the HUS is removed. Approach based on regarding the HUS as an implicit price subsidy.

	Gas expenditure as share of total expenditure when the HUS is present (average)	**Change in gas expenditure share if the HUS is removed (average)**
2014	4.30%	
2016	3.72%	.
2017	4.02%	10.89%
2018	5.28%	10.01%

Table 17. Loss of consumer surplus if the HUS was removed entirely. Approach based on regarding the HUS as a demand shifter.

A. loss of CS (conditional mean among HUS recipients), in 2014 UAH.

	Consumption quartile			
Income quartile	**1**	**2**	**3**	**4**
1	895.42	1,347.37	1,685.75	2,111.98
2	1,129.69	1,627.02	1,931.51	2,408.13
3	1,247.10	1,802.13	2,158.18	2,679.31
4	1,256.42	2,073.45	2,427.17	3,076.27

B. loss of CS as share of income (conditional among HUS recipients)

	Consumption quartile			
Income quartile	**1**	**2**	**3**	**4**
1	5.77%	8.87%	10.83%	13.46%
2	3.89%	5.73%	6.76%	8.28%
3	2.94%	4.04%	4.87%	5.93%
4	1.82%	2.89%	3.32%	4.12%

Table 18. Loss of consumer surplus if the HUS was halved. Approach based on regarding the HUS as a demand shifter.

A. loss of CS (conditional mean among HUS recipients), in 2014 UAH.

	Consumption quartile			
Income quartile	**1**	**2**	**3**	**4**
1	139.70	172.59	197.34	232.20
2	174.61	207.71	229.79	268.69
3	195.93	235.25	260.72	304.39
4	212.35	272.35	297.40	353.70

B. loss of CS as share of income (conditional among HUS recipients)

	Consumption quartile			
Income quartile	**1**	**2**	**3**	**4**
1	0.90%	1.13%	1.27%	1.48%
2	0.60%	0.73%	0.80%	0.92%
3	0.46%	0.53%	0.59%	0.67%
4	0.31%	0.38%	0.41%	0.47%

Table 19. Summary of CS losses/gains from an alternate HUS, which grants to households below the poverty line an amount equal to the poverty line income minus their income.

Group	**Number and share out of N=7334 (share in parentheses)**	**Mean CS change (2014 UAH)**
No HUS, no new HUS	N=2383 (32.49%)	Zero
No HUS, gets new HUS	N=257 (3.50%)	1769.48
Did get HUS, does not get new HUS	N=3934 (N=53.64%)	-2239.63
Did get HUS, gets new HUS (possibly different amount)	N=760 (10.36%)	-3.97
Summary	**13.86% of people with gas heat would get the new HUS v. 64.00% of existing HUS**	**Unconditional mean CS change -321.54 UAH (2014 UAH)**

Table 20. Summary of winners and losers from an alternate HUS, which grants to households below the poverty line an amount equal to the poverty line income minus their income.

A. percentage that does not get HUS gas AND would NOT get the proposed subsidy					**A. Associated CS change (2014 UAH)**			
	Consumption Quartile				**Consumption Quartile**			
Income quartile	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
1	25.74%	22.15%	11.87%	6.17%	0	0	0	0
2	57.43%	48.05%	29.32%	14.81%	0	0	0	0
3	62.92%	53.13%	37.63%	26.59%	0	0	0	0
4	75.00%	60.51%	54.17%	39.63%	0	0	0	0

B. percentage that does not get the current HUS gas BUT would get the proposed HUS					**B. Associated mean CS gain (2014 UAH)**			
	Consumption Quartile				**Consumption Quartile**			
Income quartile	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
1	28.68%	17.45%	5.93%	0.77%	1348.23	1541.55	1606.13	2139.25
2	4.95%	5.71%	2.41%	1.68%	1838.33	1972.41	2255.64	2303.52
3	4.49%	3.98%	1.21%	0.68%	1856.71	2358.69	2445.34	2343.97
4	0.00%	0.32%	0.68%	0.35%		1408.71	2664.3	1735.04

C. percentage that does get the HUS gas AND would lose it					**C. Associated mean CS change (2014 UAH)**			
	Consumption Quartile				**Consumption Quartile**			
Income quartile	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
1	27.21%	38.26%	50.80%	61.85%	-935.89	-1391.99	-1751.54	-2160.31
2	33.66%	40.26%	60.91%	73.13%	-1134.68	-1626.17	-1950.52	-2426.73
3	28.09%	39.49%	55.08%	67.71%	-1218.19	-1807.41	-2175.81	-2698.51
4	25.00%	39.17%	44.46%	58.86%	-1256.42	-2073.45	-2435.83	-3078.92

D. percentage that does get the HUS and would still get it under the proposal					**D. Associated mean CS change (2014 UAH)**			
change	**Consumption Quartile**				**Consumption Quartile**			
Income quartile	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
1	18.38%	22.15%	31.40%	31.21%	381.24	112.39	-73.70	-382.90
2	3.96%	5.97%	7.36%	10.38%	829.96	436.74	263.33	102.93
3	4.49%	3.41%	6.07%	5.02%	745.95	277.89	197.74	44.49
4	0.00%	0.00%	0.68%	1.16%			847.24	23.62

Table 21. Summary of CS losses/gains from an alternate HUS, which grants to households below 150% of the poverty line an amount equal to 150% of poverty line income minus their income.

Group	Number and share out of N=7334 (share in parentheses)	Mean CS change (2014 UAH)
No HUS, no new HUS	1745 (23.79%)	Zero
No HUS, gets new HUS	895 (12.20%)	2,236.87
Did get HUS, does not get new HUS	2207 (30.09%)	-2,394.12
Did get HUS, gets new HUS (possibly different amount)	2487 (33.91%)	371.39 (has both winners and losers)
Summary	**46.11% of people with gas heat would get the new HUS v. 64.00% with existing HUS**	**Unconditional mean CS change -321.54 UAH (2014 UAH)**

Table 22. Summary of winners and losers under an alternate HUS, which grants to households below 150% of the poverty line an amount equal to 150% of poverty line income minus their income.

A. percentage that does not get HUS gas AND would NOT get the proposed subsidy					A. Associated CS change (2014 UAH)			
	Consumption Quartile				Consumption Quartile			
Income quartile	1	2	3	4	1	2	3	4
1	6.62%	6.49%	4.05%	2.70%	0	0	0	0
2	36.63%	21.30%	16.47%	8.55%	0	0	0	0
3	52.81%	43.47%	29.14%	20.62%	0	0	0	0
4	71.15%	55.73%	49.23%	37.31%	0	0	0	0

B. percentage that does not get the current HUS gas BUT would get the proposed HUS					B. Associated mean CS gain (2014 UAH)			
	Consumption Quartile				Consumption Quartile			
Income quartile	1	2	3	4	1	2	3	4
1	47.79%	33.11%	13.75%	4.24%	1,624.47	1,856.99	1,941.35	1,915.75
2	25.74%	32.47%	15.26%	7.94%	2,217.62	2,127.03	2,274.23	2,688.42
3	14.61%	13.64%	9.71%	6.65%	2,282.32	2,779.95	2,629.48	3,104.02
4	3.85%	5.10%	5.62%	2.67%	1,884.31	2,382.09	2,691.87	2,529.76

C. percentage that does get the HUS gas AND would lose it					C. Associated mean CS loss (2014 UAH)			
	Consumption Quartile				Consumption Quartile			
Income quartile	1	2	3	4	1	2	3	4
1	11.76%	10.74%	12.16%	15.99%	-1,012.73	-1,448.45	-1,846.6	-2,297.97
2	15.84%	18.96%	26.64%	33.44%	-1,199.25	-1,621.13	-1,972.03	-2,461.98
3	19.10%	27.56%	37.48%	47.63%	-1,315.78	-1,816.58	-2,209.26	-2,692.22
4	19.23%	33.12%	37.82%	48.78%	-1,315.33	-2,105.22	-2,447.64	-3,131.62

D. percentage that does get the HUS and would still get it under the proposal					D. Associated mean CS change (2014 UAH)			
	Consumption Quartile				Consumption Quartile			
Income quartile	1	2	3	4	1	2	3	4
1	33.82%	49.66%	70.04%	77.07%	824.33	470.47	250.81	16.65
2	21.78%	27.27%	41.63%	50.08%	963.59	647.36	429.97	191.76
3	13.48%	15.34%	23.67%	25.10%	1,481.21	908.58	733.47	463.74
4	5.77%	6.05%	7.33%	11.24%	1,486.74	903.66	725.27	490.36

Table 23. Summary of CS gains and losses under an alternate HUS, which grants to households below 200% of the poverty line an amount equal to 200% of poverty line income minus their income.

Group	**Number and share out of N=7334 (share in parentheses)**	**Mean CS change (2014 UAH)**
No HUS, no new HUS	N=1121 -15.28%	Zero
No HUS, gets new HUS	N=1519 -20.71%	2,612.95
Did get HUS, does not get new HUS	N=1010 -13.77%	-2,549.03
Did get HUS, gets new HUS (possibly different amount)	N=3684 -50.23%	655.59
Summary	**70.94%% of people with gas heat would get the new HUS v. 64.00% with existing HUS**	**Unconditional mean CS change 519.46 UAH (2014 UAH)**

Table 24. Summary of winners and losers under an alternate HUS, which grants to households below 200% of the poverty line an amount equal to 200% of poverty line income minus their income

A. percentage that does not get HUS gas AND would NOT get the proposed subsidy					A. Associated CS change (2014 UAH)			
	Consumption Quartile				Consumption Quartile			
Income quartile	1	2	3	4	1	2	3	4
1	0.00%	0.00%	0.00%	0.00%	0	0	0	0
2	17.82%	11.17%	10.17%	4.27%	0	0	0	0
3	32.58%	22.73%	16.84%	12.21%	0	0	0	0
4	51.92%	39.49%	39.69%	30.36%	0	0	0	0

B. percentage that does not get the current HUS gas BUT would get the proposed HUS					B. Associated mean CS change (2014 UAH)			
	Consumption Quartile				Consumption Quartile			
Income quartile	1	2	3	4	1	2	3	4
1	54.41%	39.60%	17.80%	6.94%	1,831.71	2,098.49	2,250.15	2,333.44
2	44.55%	42.60%	21.55%	12.21%	2,358.36	2,424.02	2,608.05	2,944.53
3	34.83%	34.38%	22.00%	15.06%	2,371.4	2,677.93	2,742.01	3,206.92
4	23.08%	21.34%	15.16%	9.62%	2,829.32	2,819	3,257.93	3,353.18

C. percentage that does get the HUS gas AND would lose it					C. Associated mean CS change (2014 UAH)			
	Consumption Quartile				Consumption Quartile			
Income quartile	1	2	3	4	1	2	3	4
1	0.00%	0.00%	0.00%	0.00%				
2	5.94%	8.57%	10.31%	13.59%	-1,081.83	-1,640.7	-1,976.97	-2,467.53
3	7.87%	13.07%	17.75%	21.71%	-1,547.84	-1,851.87	-2,233.09	-2,741.04
4	11.54%	19.11%	25.21%	30.24%	-1,381.57	-2,149.59	-2,515.6	-3,205.44

D. percentage that does get the HUS and would still get it under the proposal					D. Associated mean CS change (2014 UAH)			
	Consumption Quartile				Consumption Quartile			
Income quartile	1	2	3	4	1	2	3	4
1	45.59%	60.40%	82.20%	93.06%	962.34	704.8	514.12	308.02
2	31.68%	37.66%	57.97%	69.92%	1,264.96	884.48	695.02	520.91
3	24.72%	29.83%	43.40%	51.02%	1,526.19	1,011.37	834.63	620.64
4	13.46%	20.06%	19.93%	29.78%	1,588.57	1,043.25	979.23	828.64

Table 25. Government disbursements in the HBS sample served by gas heat under the current and proposed HUS reforms. Nominal UAH.

	current gas HUS	scenario 1 (eliminate gas HUS)	scenario 2 (halve the gas HUS)	scenario 3.a (poverty line income)	scenario 3.b (150% poverty line income)	scenario 3.c (200% poverty line income)
Year	**total gas HUS if gasheat==1 (thou. nom. UAH)**	**total gas HUS if gasheat==1 (thou. Nom. UAH)**	**total gas HUS if gasheat==1 (thou. Nom. UAH)**	**total gas HUS if gasheat==1 (thou. Nom. UAH)**	**total gas HUS if gasheat==1 (thou. Nom. UAH)**	**total gas HUS if gasheat==1 (thou. Nom. UAH)**
2014	205.20					
2016	22,139.13					
2017	25,862.73	0	12,931.37	5,008.23	35,511.43	93,002.43
2018	19,136.31	0	9,568.16	3,366.00	29,675.21	84,368.43
2019	9,808.94					
Total for 2017 and 2018	44,999.04	0	22,499.52	8,374.228	65,186.64	177,370.9

Appendix.

Table A.1. Regression results. Sample: HBS from 2017 and 2018, households who use natural gas for space heating.

	(1)	(2)
	Dep. Var. log gas consumption	Dep. Var.: log gas consumption - log gas price
SFhome	0.2457874 ***	0.1832308 ***
	(0.0217952)	(0.0207136)
otherlivingarrangement	0.2927151 ***	0.2310566 ***
	(0.0452543)	(0.0429507)
ownhome	0.1573989 ***	0.0552763
	(0.0501661)	(0.0476728)
indepheat	0.4040991 ***	0.3578385 ***
	(0.0284905)	(0.0270496)
gaswaterheater	0.1151332 ***	0.105694 ***
	(0.0219266)	(0.0207873)
hsize	-0.0093522	-0.0286021 **
	(0.0130572)	(0.0123918)
h_chdor	0.0104689	0.0038202
	(0.0144838)	(0.01372)
h_elder	0.0180285	-0.0057968
	(0.0121103)	(0.0114524)
lnetincome	0.2768584 ***	0.3283539 ***
	(0.0201144)	(0.0186002)
lhdd	0.4421915	0.611222
	(0.4410221)	(0.4180984)
limplicitprice	-0.1701062 ***	
	(0.0121024)	
		0.0792804 ***
		(0.0023962)
sliv 2	0.0851475 ***	0.063182 ***
	(0.0197632)	(0.0187473)
sliv 3	0.1365882 ***	0.1035272 ***
	(0.0270096)	(0.0256225)
sliv 4	0.2956979 ***	0.2552708 ***
	(0.042312)	(0.0401329)
year 2018	0.0493169 ***	0.031124 *
	(0.0169853)	(0.0159636)
_cons	-0.441374	-2.361648
	(3.631441)	(3.442735)
Observations	7,334	7,334
R-squared	0.166	0.2541

*** p<0.01, ** p<0.05, * p<0.1.