Unconditional Cash Transfers and Energy Poverty in South Africa

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Abstract

There has been a rise in state-sponsored cash transfer programs in Africa, yet we know little about their potential impact on energy poverty. In this study, we examine the effect of a large-scale unconditional cash transfer program in South Africa using rich panel data. We employ instrumental variable estimation to address endogeneity by exploiting discontinuities in age eligibility for the transfer as an instrument. We find that beneficiary households experienced a 7.5 percent reduction in energy poverty, which works through increases in asset accumulation. The decreasing effects of unconditional cash transfer on energy poverty are more pronounced among female-headed and native Black South Africans households. The results are consistent across different measures of energy poverty and alternative estimation techniques that address endogeneity. Overall, the findings reveal that unconditional cash transfers can be considered a viable policy tool to address energy poverty.

Keywords: Unconditional cash transfers, Energy poverty, asset accumulation, South Africa

JEL Codes: D12; I32; I38, O13; Q41

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1. Introduction

Households' fuel choice is paramount in the climate change discourse. A smooth transition from households' use of unclean to cleaner energy would require public education on the importance of climate change mitigation on the one hand (Feinstein & Mach, 2020; P. Koomson & Koomson, 2024) and sustainable financial support to motivate these households to embrace or commit to transitioning on the other hand (Acheampong, 2023; I. Koomson & Danquah, 2021). According to the World Health Organization, a third of the world's population utilizes inefficient energy stoves for cooking, causing harmful air pollution. A substantial portion of ambient air pollution and premature deaths are attributable to the use of unclean fuels by households for cooking, lighting, and heating (World Health Organization, 2023). In Africa alone, 970 million people are deprived of access to modern, affordable, dependable, and clean cooking fuel (International Energy Agency, 2022). It is worth highlighting that most households are energy-poor.

To date, there is no universally accepted definition of energy poverty. Despite being context-specific, the various definitions widely consider it as the lack of cheaper and reliable modern energy. According to Reddy et al. (2000), energy poverty is the inability to obtain adequate cheap, reliable, and environmentally friendly energy services. Due to its adverse impacts on overall well-being (Awaworyi Churchill et al., 2020a), energy poverty is considered a global issue. Alleviating energy poverty in Africa would require addressing both supply and demand challenges. Some economists have argued that improving households' access to finance can lift them out of energy poverty (I. Koomson & Danquah, 2021). This is because increases in household incomes influence a household's choice of fuel, as those who use traditional fuels switch to cleaner fuels, the so-called energy ladder (Hosier & Dowd, 1987; Leach, 1992).

A myriad of studies has focused on how cash transfers can improve the economic lives of the poor. Evidence on the impacts of cash transfers (both conditional and unconditional) on welfare, particularly in developing countries are mixed but highly skewed towards positive impacts (Fiszbein & Schady, 2009; Haushofer & Shapiro, 2018; Millán et al., 2019). A key question regarding cash transfers has been whether poor people need cash or not and whether there should be conditions on what and how they spend the money. There are concerns that cash transfers without conditions allow beneficiaries to spend on frivolous needs like alcohol, festive activities, and funeral activities (Banerjee et al., 2019).

However, this economic decision depends on individual priorities and willingness. For instance, as incomes rise, people who prioritize health and the environment may decide to spend less on inefficient energy technologies that could increase their carbon footprint and hurt the environment (Jayachandran, 2022).

Despite a growing number of studies about cash transfers and their importance of alleviating energy poverty, there is a paucity of research focusing on the impact of cash transfers on energy poverty. (Nawaz & Iqbal, 2020). To contribute to the literature, we embark on an empirical exercise to answer the research question: Can unconditional cash transfer (UCT) alleviate energy poverty? The answer to this question is important as it determines whether cash transfers can be a sustainable policy lever to enhance energy transition in the developing world or complement existing programs to alleviate energy poverty. We answer this question by focusing on South Africa's Child Support Grant program (CSG), one of the largest social grant programs in Africa, documented to have improved educational outcomes, food security, health, and nutrition of beneficiaries (Agüero et al., 2006; Coetzee, 2013; d'Agostino et al., 2018; Heinrich et al., 2012). The CSG was introduced in 1998 by the South African government to help vulnerable children and low-income families cater to their basic needs. Although South Africa has the most extensive system of governmental support, coupled with improvements in electrification rates[†], more than 50 percent of households are energy-poor (Ye & Koch, 2021), making its context unique for analysis.

We leverage the exogenous variation in eligibility induced by changes in age requirements for CSG to resolve endogeneity and isolate its causal effect on energy poverty. The age eligibility was increased from 14 years to 16 years in 2010 and further to 18 years 2012. The discontinuity in age eligibility is similar to a fuzzy regression discontinuity, hence, we estimate the local average treatment effects of the CSG in an IV framework. We rely on three waves of the National Income Dynamics Panel Study (NIDS), a nationally representative data that allows us to compute a multidimensional energy poverty measure[‡]. Our estimates show that CSG significantly decreases energy poverty. Receiving CSG reduces the likelihood of being energy-poor by 7.5 percentage points. The results are robust to a battery of checks, including alternative measures of energy poverty. We further examine mechanisms that explain our findings and

[†] This is due to the roll-out of the national electrification program.

[‡] The Multidimensional Energy Poverty Index considers both subjective and objective dimensions of energy poverty.

find that savings and investment ability are important pathways in the link between CSG receipt and energy poverty reduction

This study offers two significant additions to the existing body of work. First, we add to a small body of work documenting the effects of transfer programs on household energy choice. Fewer studies have analyzed the effect of cash transfers on fuel choice (Chakrabarti et al., 2023; Hanna & Oliva, 2015; Nawaz & Iqbal, 2020). These studies find that cash transfers promote the use of modern fuels. Unlike these papers, which analyze how cash transfers influence fuel choice, we examine its implication for energy poverty using a multidimensional measure that captures a broader picture of well-being by considering dimensions like access to modern energy sources and energy choice[§]. Moreover, our study differs from previous studies by examining some potential pathways via which UCTs may affect energy poverty. Our findings offer lessons from which policy discussions on alleviating energy poverty in emerging economies would benefit.

Second, we add evidence to a growing literature on energy poverty (Apergis et al., 2022; Awaworyi Churchill et al., 2020a; Thomson et al., 2017). This study is closely related to a strand of this literature that examines the determinants of energy poverty, measurement, and strategies for mitigation (Boardman, 2013; I. Koomson et al., 2023; I. Koomson & Danquah, 2021; Monyei & Adewumi, 2017; Nussbaumer et al., 2013; Ye & Koch, 2021). Koomson and Danquah (2021) show that increased financial inclusion decreases energy poverty due to its income-enhancing effect. We present complementary evidence showing that social protection programs like UCTs may lift households out of energy poverty.

The subsequent sections of this paper are organized as follows:. In Section 2, we provide the background and conceptual link between cash transfers and energy poverty. Section 3 discusses the data used, while the research design is detailed in Section 4. Section 5 presents the main results and discusses potential channels, while the final section concludes.

2. Background and Conceptual link between cash transfers and energy poverty

2.1. Why South Africa?

[§] For instance, some households use traditional fuels because they do not have access to modern fuels like electricity. Focusing on a multidimensional measure of energy poverty gives a better picture of whether fuel choices are conditional on access (availability) and or affordability besides preferences. A closely related work to our study is Gelo et al. (2023) who evaluates the effects of the Old Age pension eligibility program on fuel choice.

The South African government introduced various social protection programs and improved on existing ones post-apartheid to reduce poverty and inequality. Similar to economies with comparable income levels, South Africa has the largest system of state assistance, with one-third of the population being direct recipients (Miyajima, 2024). In 2021, 13 million children under age 18 benefited from the CSG program, which is one of the largest social grant programs in Africa (Westphal & Makondo, 2022). Evidence shows that the rollout of the CSG has resulted in widespread improvements in the socioeconomic and health outcomes of beneficiary households (See e.g., Agüero et al., 2006; Coetzee, 2013; d'Agostino et al., 2018). Energy poverty remains high in South Africa amid challenges like high unemployment rates, inequality, and the energy crisis.

The absence of reliable electricity, coupled with an unaffordable energy supply has pushed many South Africans into energy poverty. More than 50 percent of households in South Africa are energy-poor. (Ye and Koch, 2021) and this is predominant among black households (I. Koomson et al., 2022; Lin & Okyere, 2023). Households rely on unclean fuels for cooking, heating, and lighting and a mix of both traditional and modern fuels in some cases (Wernecke et al., 2024). The government introduced certain pro-poor energy policies such as the Free Basic Electricity to support households' basic energy needs[**].

However, the Free Basic Electricity policy, for instance, has been criticized for reaching only a small share of eligible households, providing an insufficient amount of electricity subsidy to cover basic energy needs, and having no significant impact on energy poverty (Lin & Okyere, 2023; Masekameni et al., 2018; Mvondo, 2010). Given South Africa's energy poverty rate, it is imperative to investigation whether social grant programs aimed at improving households' welfare may potentially be effective policy instruments to tackle energy poverty or complement existing programs.

2.2. Cash Transfers and Energy Poverty Nexus

The socioeconomic outcomes of cash transfers (conditional and unconditional) are well-documented in the literature. Several studies find long- and short-term positive impacts of conditional cash transfers on poverty, nutrition, and education (Fiszbein & Schady, 2009; Millán et al., 2019). Some studies have discovered that UCT initiatives in Africa increase asset accumulation, incomes, and

[**] Under the Free Basic Electricity program, eligible households receive 50kWh of electricity monthly.

psychological well-being and decrease food security (Handa et al., 2018; Haushofer & Shapiro, 2018). UCTs have been shown to have indirect positive effects on outcomes initially not considered by such programs.

There are numerous pathways in which cash transfers can impact energy poverty. First, credit and financial constraints are major impediments to the adoption of clean energy technology in the developing world (Berkouwer & Dean, 2022; I. Koomson & Danquah, 2021). Cash transfers reduce the burden of credit-constrained households by increasing their purchasing power. Secondly, transfers allow households to save and invest in assets to accumulate wealth. Accumulating wealth may influence their energy consumption preferences and increase the take-up of cleaner energy sources. A study conducted in Zambia shows evidence of increases in asset accumulation among beneficiary households of a child grant program (Handa et al., 2018). Third, UCTs like the child support program may reduce the burden of childcare and job search costs, thereby enabling certain members of the household, particularly women to participate in the labor market (Williams, 2007). Engaging in income-generating activities like non-farm enterprises (NFE) provides another stream of income to sustain their livelihoods over time and reduce energy poverty (I. Koomson et al., 2023). Eyal and Woolard (2011) find that CSG increased the likelihood of employment and labor force participation for women with eligible children. Tondini {Citation}(2022) also finds that single mothers with eligible children were more likely to search for jobs.

High income and consumption poverty rates have been linked to high energy poverty (Awaworyi Churchill et al., 2020b; Sadath & Acharya, 2017). Energy poverty is more prevalent among poor households. Though most UCTs are not designed to influence energy choices, they have the potential to reduce income and consumption poverty, thereby decreasing energy poverty in the process. The pieces of evidence above suggest that UCTs have the potential to impact energy poverty through the channels discussed above.

From the evidence above, we summarize the link between cash transfer, asset accumulation, and energy poverty in Figure 2.

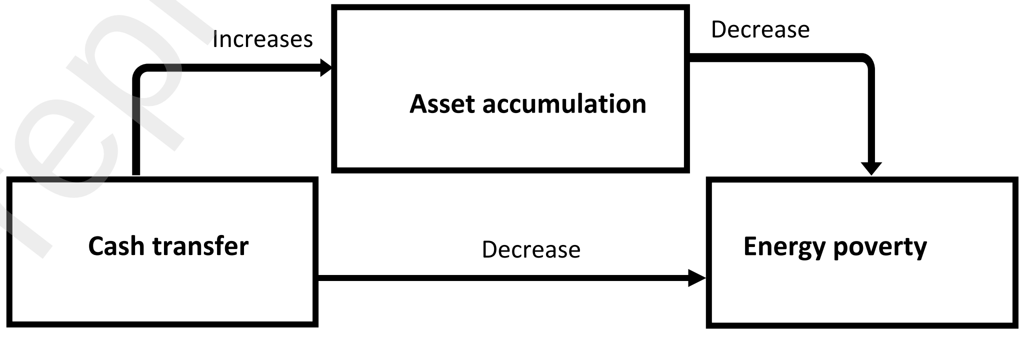


Figure 2: Conceptual relationship between cash transfer, asset accumulation and energy poverty (Source: Authors' Construct)

2.3. The Child Support Grant (CSG) Program

In 1998, the South African government implemented the CSG as a means-tested UCT. The program aims to help low-income families cater to the basic needs of children. Eligibility depends on a child's age and income of the primary caregiver of a child. The parent/caregiver receives monthly transfers on behalf of each eligible child.[††] The age and income threshold for eligibility, as well as the maximum amount of grant per child, have changed over time. Children under age 7 were eligible when the program began in 1998, but the cut-off age was increased to include children under 18 by 2012.

As seen in table A1, the age limit changed from 7 to 9 years in 2003, 14 years in 2005, and 16 years in 2010. Due to these changes, children born in January 1994 became eligible until they turned 18. The income threshold was set at R800 in urban areas and R1,100 in rural areas from 1998 to 2008. In 2008, the government increased the threshold to 10 times the amount of the grant paid to single caregivers and double for married couples (Woolard et al., 2011).[‡‡] In addition to these changes, the monthly grant amount which was set at R100 at the inception of the program increased to R510 in October 2023) (South African Social Secuirty Agency, 2023).

Table 1: CSG program details

Date	Age limit	Grant amount (in Rand)	Caregiver means-test (in Rand)
Apr-98	7	100	1,100 rural, 800 urban
Apr-03	9	160	1,100 rural, 800 urban
Apr-04	11	170	1,100 rural, 800 urban
Apr-05	14	180	1,100 rural, 800 urban
Oct-08	14	230	2,300
Jan-09	15	240	2,400
Jan-10	16	250	2,500
Jan-11	17	260	2,600
Jan-12	18	280	2,800

Source: National Treasury Reports.

[††] Caregivers are awarded grants for an eligible child, with a limit of six children per household.

[‡‡] In addition to these changes, the monthly grant amount which was set at R100 at the inception of the program increased to R510 in October 2023) (South African Social Secuirty Agency, 2023).

Notes: This table shows the changes in the CSG age cut-off, means-test, and monthly amount of grants from the start of the program. The cut-off age is the age below which a child is eligible for the grant. For instance, children between ages 0 and 6 are eligible when the cut-off is 7 years. The caregiver means-test amounts are for single caregivers.

3. Data and descriptive statistics

3.1. Data

The paper uses data from the National Income Dynamic Study (NIDS), a nationally representative panel dataset implemented by the South African Labor and Development Research Unit (SALDRU) of the University of Cape Town. The NIDS comes in waves and was conducted in 2008, 2010-11, 2012, 2014-15, and 2017. It collects comprehensive information on household demographics, health, education, access to social services, employment, fertility, energy sources, income and expenditure, etc. We focus on the first 3 waves (waves 1, 2, 3) and gather information on children born between 1990 and 2012 (aged between 0 and 22) who were ultimately affected by changes in the age eligibility requirement. We used this to identify households eligible for the UCT or otherwise. We did not include data on children from Waves 4 and 5 because these waves sampled children who were all age eligible for the CSG. Hence, there would be no comparative analytical sample for them if included.

The dataset provides information on grant receipt, date of birth of a child, sources of energy for cooking, heating, lighting, etc. Our data extraction process is done by first classifying children as grant beneficiaries and non-beneficiaries using information on grant receipts. After identifying this group, we extracted household-level data by restricting the sample to include only households with children born within this cohort. Therefore, we define a beneficiary household as a household with at least one child that received grant. For each household, we include information on the household's composition, demographics of the head, head's education, energy use (cooking, lighting, heating), the number of children who receive the grant, and household income.

3.2. Measuring energy poverty

To determine the energy poverty status of a household, we use a multidimensional energy poverty index (MEPI), which is often used in research on developing countries. The MEPI is deemed a desirable measure of energy poverty because it conceptualizes and considers economic conditions and the adoption rates of renewable energy in these economies (I. Koomson & Danquah, 2021). We create the MEPI using six dimensions with assigned weights to each. The dimensions include cooking, lighting, heating, home appliances, entertainment/education, and communication (Table A1). We assign bigger weights to cooking and lighting following the literature but give bigger weight to cooking than lighting since cooking demands a larger share of energy in most households (I. Koomson & Danquah, 2021; Nussbaumer et al., 2013). As shown in Table A2, each indicator is a dummy variable equal to 1 if the household is deprivation in that indicator. That is, we assign 1 to the use of unclean fuel for cooking and zero to clean fuels. Similarly, if a household does not have access to a particular home appliance, it is coded as 1 to reflect deprivation.

3.3. Descriptive statistics

Table 2 shows summary statistics for all the variables used in the main analysis. The table indicates that about 31 percent of the households are energy-poor, while 35 percent of them are CSG recipients. The average age of household heads is 48 years, with the majority of them being female and black. Most heads are educated and married. The average household size is 5.

Table 2: Summary statistics

Variable	Mean	SD
Energy poverty (0/1)	0.305	0.460
Energy Poverty Index	0.273	0.342
UCT	0.349	0.477
Age	47.94	15.72
Female head	0.662	0.473
Urban	0.492	0.500
Race		
Black	0.809	0.393
Colored	0.145	0.352
Asian/Indian	0.014	0.118
White	0.032	0.177
Marital status		
Married	0.419	0.493
Living with partner	0.095	0.293
Widow/widower	0.185	0.388
Divorced/separated	0.037	0.189
Never married	0.264	0.441
Education		
No education	0.207	0.151
Primary	0.426	0.405
Secondary	0.344	0.495
Tertiary	0.023	0.475
Household size	5.204	2.597
Household income	15.02	5.764
Observations	10925	

Note: Household income is transformed using inverse sine hyperbolic transformation

4. Empirical and Identification strategy

We estimate the association between UCT and energy poverty, using ordinary least squares (OLS) and specify the preliminary model as:

$$EPov_{it} = \alpha + \beta UCT_{it} + \delta X_{it} + \gamma_p + \omega_t + \varepsilon_{it} \qquad (1)$$

Hence, $EPov_{it}$ represents the energy poverty status of household i at time t. UCT_{it} is a binary variable indicating whether a household, i, is a beneficiary of the CSG or otherwise at time t. X is a vector of control variables that potentially influence energy poverty (see e.g., (I. Koomson et al., 2022; Lin & Okyere, 2023; Ngarava et al., 2022). The variables include age, gender, location of residence, racial background, marital status, household size, educational status of the household head, and household income. γ_p and ω_t denote wave and province fixed effects, while ε is the error term.

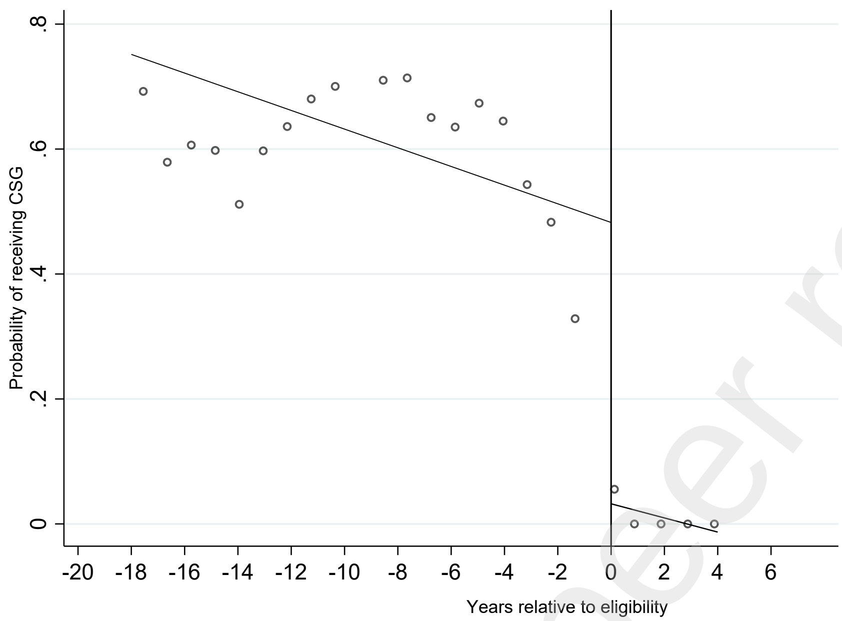
As evident in previous studies, the estimated relationship between UCT_{it} and various socioeconomic outcomes may be biased due to endogeneity caused by omitted variable bias or bidirectional causality (Fernald et al., 2008; Ohrnberger et al., 2020). Households' decision to enroll and benefit from the UCT program can be endogenous because such decisions can be informed by unobserved and contextual factors that potentially affect both energy poverty and their UCT beneficiary status (Clougherty et al., 2016; Ohrnberger et al., 2020). Premised on previous studies that have focused on identification in binary choice models (Clougherty et al., 2016; Lee, 1979), we can infer that the decision to enrol in the UCT program is based on potential socioeconomic outcomes and benefits under alternative choices, while the observed outcomes are final outcomes of the decision process. This implies that the UCT beneficiary status and energy poverty as an outcome can be bidirectionally related.

To address endogeneity bias, we use an instrumental variables (IV) estimation approach in which we instrument for UCT beneficiary status using discontinuities in the age eligibility for UCT benefit in South Africa. From 1 January 2010, the age cut-off for eligibility was extended from 14 years to 16 years, and to 18 years in 2012. The change in the reform made some cohorts eligible and others ineligible, such that those born after 1 January 1994 became eligible until they turned 18. We classify a household as a UCT recipient household if there is at least one eligible child, using the month and year of birth. Our identification strategy is similar to a fuzzy regression discontinuity, where we compare those above the cut-off to those below the cut-off to estimate the local average treatment effects.

In line with the relevance condition for instrument validity, it is expected that households that satisfy the age eligibility criterion are a step closer to being enrolled in the UCT program (Woolard et al., 2011; SASSA, 2023). This is also depicted in Figure 1, which plots the probability of receiving UCT against years relative to eligibility (number of years above and below the cut-off age). Children eligible for the transfer are on the left of the age cut-off, while those who are ineligible lie on the right. The probability of receiving the grant is zero if a child is a year or more older than the cutoff age (right of cut-off), but the probability increases as a child's age falls significantly below the cutoff (left of cutoff). The jump in the probability of receiving the grant at the cutoff shows that receiving UCT is determined by the age cohort of the child and supports the assumption that changes in the age eligibility criterion provide an exogenous variation in exposure to the grant. By inference, we expect a positive association between the age eligibility criterion and a household's UCT beneficiary status. Since the age eligibility criterion is a strict condition and the first step toward a household's acceptance into the UCT program, we do not expect the eligibility criterion to directly influence a household's energy poverty status unless it does so by first defining its beneficiary status. This also implies that the instrument satisfies the exclusive restriction condition required for instrument validity.

In addition to the standard IV estimator, we utilize the Lewbel (2012) IV method, which use internally produced instruments, to conduct robustness checks on our main findings. We also exploit various cut-offs, weights, and methods to obtain the energy poverty construct in order to evaluate the sensitivity of our estimates.

Figure 1: Age eligibility and grant receipt



Note: The figure illustrates the relationship between grant receipt and age eligibility. Individuals eligible for the grant lie on the left of the cutoff, while those who are ineligible lie on the right.

5. Results

5.1. Baseline results

The estimated link between receipt of UCT (i.e., CSG) and energy poverty is reported in Table 3. Overall, our findings indicate that receipt of the UCT is associated with a reduction in energy poverty. Specifically, we report results produced from the OLS model in Column 1 and observe that being a UCT recipient is associated with a 0.4% decrease in energy poverty, but this is not statistically significant. The small and insignificant coefficient indicates that the OLS coefficient may be biased due to endogeneity (either due to omitted variable bias or reverse causality) (Appau et al., 2021; Bhalotra & Clots-Figueras, 2014).

In Column 2, we use an IV model in which the age eligibility criterion for the grant is used as an instrument for UCT. As expected, the first-stage results show that having an age-eligible child increases a household's chances of becoming a UCT beneficiary by 22.5%. The F-statistic exceeds the threshold value of 10, indicating that our instrument is not weakly correlated with the UCT beneficiary status (Stock & Yogo, 2002). After addressing the endogeneity problem, we find that being a UCT recipient is associated with a 7.5% decrease in energy poverty and this coefficient is statistically significant at the 5% alpha level. We can infer that the endogeneity problem rendered our OLS estimate insignificant. Since the IV model satisfies all statistical requirements, the estimate from the IV model is our preferred option. This finding is consistent with those established in previous studies, which find that UCTs promote cleaner fuel use among beneficiary households in Pakistan (Nawaz & Iqbal, 2020), Malawi and Zambia (Chakrabarti et al., 2023) due to increased purchasing power emanating from improvements in household income. Unlike these studies, we employ a multidimensional construct of energy poverty and explore its linkage with UCT.

Table 3: UCT and Energy Poverty: Baseline results - OLS and IV results

	OLS	IV
	(2)	(4)
UCT	-0.004	-0.075**
	(0.015)	(0.036)
Controls	Yes	Yes
Province fixed effects	Yes	Yes
Wave fixed effects	Yes	Yes
First stage		
Age eligibility		0.225***
		(0.006)
F-statistic		1281.97
Observations	10,925	10,925

Note: This table shows the OLS and IV estimates of the effects of UCT on energy poverty. Robust standard errors are shown in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

5.2. Gender and Race

To explore the gender and racial differences in the effect of UCT on energy poverty, we estimated separate sub-sampled models for male-female household heads and for Black/African and Non-black South Africans. As shown in Columns 1 and 2 of Table 4, we observe that being a beneficiary of UCT decreases energy poverty by 17.7% in female-headed households, but the relationship is not statistically significant in male-headed homes. In Columns 3 and 4, we see that receipt of UCT is associated with a 16.8%

reduction in energy poverty in Black/African households, but this outcome is not statistically significant in Non-black South African homes. This implies that the grant is mainly significant or makes a difference in reducing energy poverty among female-headed homes and Black/African South African households. Since female-headed and Black/African homes are documented as experiencing socioeconomic deprivations in South Africa, the findings of this study show that the CSG program is pro-poor and that it alleviates energy poverty mainly among the economically marginalized.

Table 4: UCT and Energy Poverty: gender and race

	Female	Male	Black/African	Non-black
Variables	(1)	(2)	(3)	(4)
UCT	-0.177**	-0.076	-0.168**	-0.174
	(0.089)	(0.133)	(0.077)	(0.236)
Controls	Yes	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes	Yes
Wave fixed effects	Yes	Yes	Yes	Yes
First stage				
Age eligibility	0.146***	0.120***	0.157***	0.059***
	(0.012)	(0.013)	(0.009)	(0.014)
F-stat	202.64	79.56	288.13	18.91
Observations	7,124	3,638	8,696	2,066

Note: Robust standard errors are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1

5.3. Robustness Checks

We conduct several robustness checks to ensure consistency in our findings. First, we apply the Lewbel (2012) IV model, which solves endogeneity using internally produced instruments based on heteroscedasticity in the data. Apart from using instruments produced internally, it is possible to combine both internal and external instruments in a single model to address endogeneity (Ansong et al., 2023; Kofinti et al., 2022; I. Koomson, 2024). In Table 5, Column 1 reports results produced using internal-only instruments, while Column 2 displays results that were generated by combining both internal and external instruments. After using both approaches, we observe that being a UCT recipient is associated with 5.3% and 5.9% decreases in energy poverty, respectively. This implies that the negative association between

UCT and energy poverty is consistently established irrespective of the analytical procedure used in resolving endogeneity.

Second, we apply different cut-offs, weights, and approaches to measure energy poverty to test its association with our binary indicator of UCT benefit. We begin by altering the 0.33 cut-off used to identify households in energy poverty in the main analyses. Columns 1 and 2 in Table 6 report the results of using 0.2 and 0.5 cut-offs. In Column 3, we use a MEPI construct that assigns an equal weight of 0.2 to each dimension, unlike our main measure, where unique weights were assigned to each dimension. In Column 4, we prioritized electricity by assigning it a greater weight of 0.41, unlike the main measure, which allocated a bigger weight to the cooking indicator. In Column 5, our analyses used a multidimensional score of energy poverty rather than the binary measure, so we capture the intensive rather than extensive margins in the effect of UCT on energy poverty. The outcomes of our analysis across all columns suggest that the probability of being energy-poor decreases by 6.1% to 13.9% for individuals who are recipients of UCT. It can be inferred that the decreasing effect of UCT on energy poverty is consistent across various cut-offs, weights, and conceptualizations of energy poverty.

Third, in Table A3 in the appendix, we restrict our UCT beneficiary sample to include only households with at least one child who received the grant. In doing this, households which received both disability grants and CSG benefits were dropped to remove potential contamination from receiving multiple grants. The results are reported in Column 1. In Column 2, we cluster the errors at the household level since our UCT and energy poverty variables are captured at the household level.[§§] After doing these, we consistently find that being a UCT recipient is associated with 7.3% and 7.9% decreases in energy poverty in Columns 1 and 2, respectively.

Table 5: UCT and Energy Poverty (Lewbel 2sls results)

Variables	Internal instrument (1)	Internal-external instrument (2)
UCT	-0.053***	-0.059***
	(0.019)	(0.019)
Controls	Yes	Yes
Province Fixed Effects	Yes	Yes

[§§] Clustering the errors at the household level accounts for violation of the i.i.d assumption.

Wave Fixed Effects	Yes	Yes
First stage		
Age eligibility	-	0.124***
	-	(0.008)
F-statistic	64.67	175.18
Observations	10,925	10,528
R-squared	0.293	0.289

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6: UCT and Energy Poverty (different cut-offs, weight, & measure of energy poverty)

	Cut-off 0.2	Cut-off 0.5	Equal weight	More weight on electricity	Energy poverty score
Variables	(1)	(2)	(3)	(4)	(5)
UCT	-0.123***	-0.085**	-0.136***	-0.142***	-0.063**
	(0.039)	(0.035)	(0.040)	(0.040)	(0.026)
Controls	Yes	Yes	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes	Yes	Yes
Wave fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	10,925	10,925	10,925	10,925	10,925
R-squared	0.287	0.276	0.285	0.261	0.327

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

5.4. Channels/mediation

In this section, we investigate and discuss asset accumulation as a potential channel through which UCT can influence energy poverty. Due to data constraint, we were only able to empirically assess the mediating role of asset accumulation.[***] We estimate the direct, indirect, and total effects by utilizing the instrumental variable mediation strategy (Dippel et al., 2020; Funke et al., 2023; I. Koomson et al., 2024), which can solve the endogeneity issue for both UCT and asset accumulation without needing an additional instrument for asset accumulation.

In step one, we show in Table 7 that being a recipient of UCT is associated with a 0.080 increase in asset accumulation. This finding is consistent with previous studies that show that UCTs improve household's ability to accumulate assets. (Haushofer and Shapiro, 2018; Handa et al., 2018). In the second

[***] Asset accumulation here refers to durable asset accumulation.

step, we include asset accumulation in the energy poverty model to estimate its direct, indirect, and total effects (Table 8). We find that asset accumulation is associated with a 7.46% decrease in energy poverty. The total decreasing effect of UCT on energy poverty is 0.073. Of the total effect, the indirect effect of asset accumulation is 0.059 and is statistically significant. Regarding the effect size, we found that asset accumulation accounts for about 80% of the effect of UCT on energy poverty, implying that asset accumulation serves as an important channel in the link between UCT and energy poverty.

Table 7: Energy poverty and asset accumulation

Variables	Asset accumulation
UCT	0.080***
	(0.013)
Controls	Yes
Province Fixed Effect	Yes
Wave Fixed Effect	Yes
First stage	
Age eligibility	0.225***
	(0.006)
F-statistic	1265.33
Observations	10,816

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 8: Linear IV Mediation Analysis.

Variables	Asset index
UCT [DE]	-0.014
	(0.014)
Asset index [ME]	-0.746**
	(0.354)
Decomposed mediation indicators	
Total Effect [TE]	
	-0.073*
	(0.038)
Direct Effect [DE]	-0.014

	(0.014)
Indirect Effect [IE=EM*ME]	-0.059**
	(0.029)
F-stat	64.95
Observations	10816

Notes: Mediator effect - ME; Effect on Mediator - EM. Standard errors in Parentheses. *** p<0.01, ** p<0.05, * p<0.1.

6. Conclusion

Accelerating a smooth transition from the use of unclean to cleaner energy sources among households would require public education on the importance of climate change mitigation, on the one hand, and sustainable financial support to motivate households to commit to transitioning on the other hand. There has been extensive research on the implications of energy poverty on livelihoods, health, and social wellbeing. Yet, we know little about the potential role of cash transfers in combating the energy poverty challenge.

In this study, we document the effects of one of the largest UCT programs in sub-Saharan Africa on energy poverty by focusing on South Africa's Child Support Grant (CSG). We do this by analyzing data from the first three waves of the NIDS survey and applying instrumental variable estimation to address endogeneity. We find that UCT reduces energy poverty among recipient households. Since UCTs augment household income, they have the potential to provide the purchasing power required to afford cleaner cooking fuels for cooking and lighting, thereby decreasing energy poverty. The impacts of UCT on energy poverty are pronounced for female-headed and black households. We further explore channels through which UCT may affect energy poverty and find that asset accumulation is an important operative channel. The key contribution of this paper lies in its assessment of the association between UCTs and energy poverty, an important area that has received less attention. While a handful of studies have looked at the link between cash transfers and fuel choice, we go beyond fuel choice to show evidence from a multidimensional measure that captures a broader picture of wellbeing by considering dimensions like access to modern energy sources and energy choice.

Given the relevance of energy poverty in the energy transition discourse, the findings from this study have crucial implications for policy. Since UCT can increase asset accumulation, it is worth emphasizing that UCTs have the potential to help in achieving the Sustainable Development Goals (SDGs) 3 and 7, which seek to ensure good health and wellbeing, and access to affordable, reliable, sustainable, and modern energy. It can also help to attain SDG 7, which aims to provide urgent action to combat climate change and its impacts by 2030. Previous studies have shown that energy poverty has a direct negative effect on health and well-being (Awaworyi Churchill et al., 2020b; Awaworyi Churchill & Smyth, 2021). UCTs enable households to access modern and sustainable energy through asset accumulation, thus reducing energy poverty and its impacts. As a result, there is a need to scale up existing social protection programs and introduce interventions in countries where such programs are absent.

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Appendices

Table A1: Dimensions and deprivation cut-offs for computing the energy poverty index

Dimension (weight)	Definition of deprivation
Cooking (0.41)	Household uses any fuel besides electricity, LPG, kerosene, natural gas, or biogas.
Lighting (0.13)	Household does not have access to electricity
Heating (0.13)	Household uses any fuel besides electricity, LPG, kerosene, natural gas, or biogas.
Services provision by means of household appliances (0.11)	Household does not own a fridge.
Entertainment/education (0.11)	Household does not own a television or radio
Communication (0.11)	Household does not own a mobile phone or landline

Notes: Weights assigned to the dimensions are in parenthesis.

Table A2: UCT and Energy Poverty (Baseline results with controls)

Variables	OLS (1)	IV (2)
UCT	-0.004	-0.075**
	(0.015)	(0.036)
Female	0.114	0.012
	(0.009)	(0.009)
Urban	-0.268***	-0.268***
	(0.010)	(0.010)
Age	-0.001***	-0.011***
	(0.000)	(0.002)
Household size	-0.007***	-0.011***
	(0.002)	(0.003)
Race (Base=black)		
Asian/Indian	-0.066***	-0.067***
	(0.012)	(0.012)
White	-0.009	-0.016
	(0.012)	(0.013)
Marital status (Base=married)		
Living with partner	0.101***	0.105***
	(0.015)	(0.015)
Widow/widowed	0.024*	0.023*
	(0.012)	(0.012)

Divorced/separated	0.024	0.023
	(0.018)	(0.019)
Never married	0.035***	0.034***
	(0.011)	(0.011)
Household income	-0.014***	-0.016***
	(0.002)	(0.002)
Number of recipients	0.015**	0.038***
	(0.006)	(0.012)
Educated	-0.018***	-0.018***
	(0.001)	(0.001)
Province fixed effects	Yes	Yes
Wave fixed effects	Yes	Yes
Observations	10,925	10,925
R-squared	0.292	0.291

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table A3: UCT and Energy Poverty (Additional robustness checks)

	Other grants	Cluster
Variables	(1)	(2)
UCT	-0.082**	-0.075**
	(0.038)	(0.036)
Controls	Yes	Yes
Province Fixed Effect	Yes	Yes
Wave Fixed Effect	Yes	Yes
First stage		
Age eligibility	0.222***	0.225***
	(0.006)	(0.006)
F-statistic	1203.68	1281.97
Observations	10,404	10,925

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Column 1 restricts the sample to households with no disability grant beneficiary. The sample includes only households with at least one child who receives CSG. In column 2, we cluster the errors at the household level.