Money or power? Financial infrastructure and optimal policy

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Abstract

In response to the Covid-19 crisis, 186 countries implemented direct cash transfers to households, and 181 introduced in-kind programs that lowered the cost of utilities such as electricity, water, transport, and mobile money. Does a country's financial infrastructure affect whether cash or in-kind transfers generate greater welfare improvements? We ran surveys in urban Kenya and Ghana, two areas with comparable education, cell phone ownership, and electricity connectivity. In urban Kenya, 95% of recipients prefer mobile money over electricity transfers of a similar monetary value. But Kenya is an outlier with high mobile money adoption: this increases its value and reduces the transaction cost of buying electricity credit. By contrast, in urban Ghana—where mobile money is less widespread and the transaction costs for buying electricity are higher—half of recipients prefer electricity transfers, and many are willing to forego significant value to receive electricity instead of mobile money. These results demonstrate that local financial infrastructure affects optimal government policy in response to an economic crisis. The adoption of modern financial technologies increases the efficiency of cash transfer programs, even as in-kind transfers continue to be preferred in settings where mobile money uptake is lower.

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1 Introduction

Many countries expanded social programs in response to the Covid-19 pandemic: 186 introduced or expanded cash transfer programs and 181 introduced programs lowering or postponing payments for utilities such as electricity, water, transport, and mobile money transactions (Gentilini et al. 2021a). Cash transfers are theoretically utility-maximizing, and evidence shows they lessened the economic damage of the pandemic and subsequent lockdowns (Egger et al. 2021; Banerjee et al. 2020). But in-kind transfers may be preferable if they circumvent savings constraints or reduce transaction costs, especially when transfers are inframarginal (Southworth 1945; Bruce and Waldman 1991; Currie and Gahvari 2008; Cunha 2014; Gadenne et al. 2021; Hirvonen and Hoddinott 2021). This paper asks: how does financial infrastructure affect the optimal distribution of government aid?

To compare demand for mobile money transfers (equivalent to cash where mobile money is accepted) and pre-paid electricity credit, we elicited preferences of 4,100 adults in Ghana and Kenya. We find a large and significant gap in preferences between these two settings. In urban Kenya, 95% of respondents in an incentivized experiment prefer cash, and many are willing to forego significant value to receive mobile money rather than an electricity transfer. In Accra, the capital of Ghana, just 50% prefer mobile money over pre-paid electricity of the same value in a hypothetical scenario, and many would forego significant value to receive electricity. This gap in preferences persists when control for whether survey responses are incentivized and for household baseline electricity consumption.

We argue that the leading explanation for differences in preferences is the vast difference in mobile money infrastructure between Kenya and Ghana. In Kenya, 97% of households have at least one mobile money account, 75% of adults regularly use mobile money, and mobile money is almost universally accepted for commercial transactions (Suri et al. 2021). In contrast, mobile money penetration and usage in Ghana are less than half of what they are in Kenya: only 39% of adults in Ghana have a mobile money account (Bank of Ghana 2019). Cash transfers disbursed as mobile money can thus be used more flexibly in Kenya than in Ghana, increasing demand. Moreover, the 2009 integration of the payment system of Kenya Power (Kenya's national electric utility) with Kenya's mobile money infrastructure also significantly lowered the transaction costs of buying electricity (Safaricom 2019). In Ghana most consumers must physically visit a vendor to purchase electricity credit. The time and effort required to buy electricity increases demand for electricity transfers, as these allow recipients to circumvent these costs.

Outside of this difference in mobile money penetration, urban Kenya and Ghana appear highly comparable along many important dimensions. The World Bank (2019) estimates that 94% and 91% of urban residents in Ghana and Kenya have access to electricity; 98% and 99% progress to secondary school; and there are 1.3 and 1.0 mobile cellular subscriptions per capita, respectively. Furthermore, 92% and 94% of households in urban Ghana and Kenya own a mobile phone; 73% and 74% own a radio; 17% and 16% own a bicycle; and 7% and 6% own a motorcycle (DHS Kenya 2015, DHS Ghana 2015).

We rule out other contextual differences that might have caused these results. First, respondents

in Accra, Ghana report five times greater monthly electricity spending than urban Kenyan respondents. However, the gap in preferences across contexts exists even among respondents with similar electricity consumption, and there is no correlation between electricity spending and preference for electricity over mobile money. Second, electricity tariffs are actually lower in Ghana than in Kenya, and the electricity transfers are calibrated to the cash transfer amount, so it is unlikely that this would drive preference for electricity in Ghana. Third, since Ghana's government implemented a pandemic electricity relief program, one might expect Ghanaian respondents to have trusted the implementation of a hypothetical electricity transfer more than a mobile money transfer. However, few Ghanaian respondents gave lack of trust as a reason for their choice, and receiving a government transfer does not appear to be a significant factor in respondents' preference for electricity versus mobile money.

The observed gap in preferences cannot be explained by differences in survey designs. In Ghana, the preference elicitation for all respondents was hypothetical, while in Kenya part of the sample were randomly offered an incentivized choice. While incentivizing the choice does increase the preference for cash by about 18 percentage points across respondents in Kenya, the gap in preferences between urban Kenya and Ghana persists even when controlling for this difference in survey design.

The large disparity in mobile money infrastructure between Ghana and Kenya is thus the most likely explanation for the gap in preferences. Consequently, financial infrastructure should be strongly considered in public economics debates on the optimal form of government aid, such as the choice between cash versus in-kind transfers. The GSM Association (2021) reports that, during the Covid-19 pandemic, "many governments and NGOs turned to mobile money providers to distribute income support and emergency payments rapidly and efficiently." The same report also recognizes the potential expediency of subsidizing electricity costs: "as of 2020, digital utility payments were available in 75 per cent of all countries worldwide, and as such utility payments can function as an additional bridge to increased financial inclusion." The rapid spread of mobile money and the digitization of utility infrastructure can help governments disburse transfers more quickly, cheaply, and securely. However, this expediency has not yet translated to changes in policy recommendations. In a recent World Bank report, Gentilini et al. (2021b) provide a detailed analysis of cash transfers in urban Africa, but they omit the role electric utilities can play in improving expediency and reach. The relative benefits of cash and electricity transfers will also depend on policy objectives: if the key goal is expediency, for example, then electricity transfers might be preferred in contexts where governments do not have existing mobile money relationships with citizens.

Finally, we leverage the randomized transfers in Kenya to study the impacts of mobile money and electricity transfers. We find that pre-paid electricity transfers increase electricity consumption while cash transfers do not. We find no impacts of electricity transfers on other socioeconomic outcomes, consistent with other work which finds limited social and economic impacts of rural electrification (Lee et al. 2020; Burlig and Preonas 2016), though it is worth emphasizing that transfer sizes are small here. Using non-experimental methods to evaluate the impact of electricity transfers on outcomes in Ghana suggests similar results.

2 Background

2.1 Financial infrastructure in Africa

In 2007, the Kenyan firm Safaricom launched one of the first mobile money products in the world: M-PESA. Today, 97% of Kenyan households have at least one M-PESA account, 75% of adults in Kenya use mobile money at least somewhat regularly, and 68% of households live within 1 km of an M-PESA agent (Suri et al. 2021). However, adoption is not as widespread elsewhere in Africa. In Ghana, only 39% of adults use mobile money (World Bank 2019). The usage gap is even starker: in the past 90 days only 32% of Ghanaian mobile money accounts had transacted, whereas in Kenya more than 85% of mobile money account owners had used their accounts (Bank of Ghana 2019, Central Bank of Kenya 2019).

As mobile money integrates with a country's economy, its value can increase significantly. In 2009, Safaricom partnered with Kenya Power to let utility customers pay their electricity bills using mobile money. In 2010, they launched *Nunua na MPESA* ('Buy-with-MPESA'), enabling mobile money transactions at supermarkets (Safaricom 2019). The 2013 launch of Lipa-na-MPESA ('Pay-with-MPESA') furthermore facilitated the nationwide use of mobile money for commercial transactions in Kenya.

In Ghana, these integrations have been slower to take place. 93% of respondents had to travel to an ECG office or official electricity vendor to purchase credit—only 7% have a 'smart' pre-paid meter that allows mobile top-up. Receiving electricity credit thus helps avoid the time and cost of travelling to an electricity vendor to purchase credit. Among adults who pay utility bills, 82% in Kenya had used mobile money to do so while only 23% in Ghana had (World Bank 2018).

2.2 Covid-19 policy responses

Kenya and Ghana both confirmed their first Covid-19 positive patient on March 12, 2020. Three days later, Kenya's President Uhuru Kenyatta and Ghana's President Nana Addo Dankwa Akufo-Addo both announced a broad set of physical distancing measures which eventually included bans on social gatherings in crowded places, closures of schools, universities, and congregations in places of worship, and significant travel restrictions both domestically and internationally. The economic impacts of the Covid-19 public health crisis and its accompanying policies were substantial. Egger et al. (2021) find that "*50% to 80% of sample populations in [Ghana and Kenya] report income losses during the COVID-19 period.*" Firm profits and revenues in Kenya fell by 51 and 44% respectively.

Most governments worldwide introduced or expanded cash transfer programs to help alleviate Covid-19 related economic downturns. In many African countries mobile money was an important tool for providing cash transfers, particularly for populations excluded from formal financial institutions. At the same time, many countries implemented in-kind transfer programs. These can be attractive to governments lacking infrastructure to distribute cash broadly.

The Government of Kenya in March 2020 expanded its existing social safety net, *Inua Jamii*, which provides mobile money transfers to society's most vulnerable populations—including the

elderly, orphaned children, survivors of sexual violence, people with disabilities, and pregnant mothers—and launched urban public works employment schemes (Gentilini et al. 2021a).

The government of Ghana launched an electricity relief program in May 2020, citing the importance of reliable electricity during economic downturns. All households with an electricity connection were eligible to receive a monthly transfer, with amounts pinned to March 2020 consumption (ECG 2020). Customers who consumed less than Ghana's 'lifeline' amount of 50 kWh in March were eligible to receive 50 kWh in electricity credit—worth USD 3.50—each month. All other customers would receive 50% of their March consumption. In theory, all electricity customers were eligible for transfers from May to July 2020, and eligibility for lifeline customers—around 10% of our sample—continued until March 2021. In practice not all households received transfers, and there was significant heterogeneity in the timing and consistency of monthly transfer receipt. Berkouwer et al. (2021) find significant regressivity in both the design and the implementation of Ghana's electricity program, and find that the program increased government support among recipients. The government of Ghana also implemented limited food and water relief programs, and provided an additional round of cash transfers to existing recipients of the Livelihood Empowerment Against Poverty (LEAP) Program, which targets around 5% of Ghana's poorest households with similar vulnerability criteria as Kenya's *Inua Jamii* (Dadzie and Raju 2020).

Other than the programs described above, government pandemic aid was limited. In both Kenya and Ghana, fewer than 10% of respondents reported receiving any cash, food, or other aid from the government or an NGO in the past 1-2 weeks.

3 Study Design

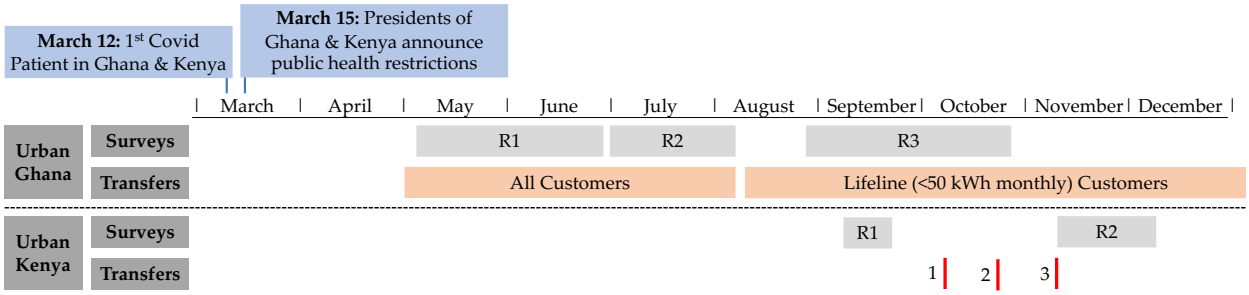
Between May and November 2020, the research team surveyed 4,122 respondents by phone, between one and three times each.

In Kenya, 1,092 respondents were asked about their willingness to pay for hypothetical electricity versus mobile money transfers.[1] 2,053 were enrolled in a randomized field experiment and randomly assigned to one of four groups: a control group, a group that received pre-paid electricity tokens, and two groups that were given an incentivized choice between mobile money or electricity transfers at different rates.

In Ghana, all 911 respondents were eligible for electricity transfers through the government's Covid-19 relief program for at least 3 months in 2020. Based on March 2020 consumption, the median respondent was eligible to receive USD 10 per month, equivalent to 95 kWh using local electricity tariffs. March consumption, on which transfers were based, averaged USD 15 in our sample. More than two-thirds of respondents received at least one electricity transfer in the first three months of the program. All respondents completed a stated preference survey on electricity versus mobile money transfers.

[1] Not all respondents in the non-incentivized arm were asked for their WTP.

Figure 1: Timeline



Timeline displaying the various study components implemented in 2020. R1, R2, R3 refer to survey rounds 1, 2, and 3. Orange boxes represent phases of government electricity transfers in Ghana. Vertical red lines represent experimental cash or electricity transfers in Kenya.

3.1 Sample

The 911 respondents located in urban Ghana had been enrolled in 2018 and 2019 as part of Klugman et al. (2019) and are distributed across western Accra. The 983 respondents located in urban Kenya were recruited through a mobile survey firm and are located in Nairobi (39%), Eldoret (11%), Mombasa (9%), and other urban areas. Finally, the 2,228 respondents located in rural Kenya were located in Western Kenya, Nyanza, and Rift Valley and had previously participated in Lee et al. (2020) or Wolfram et al. (2021). Across all samples, 80% of respondents had a pre-paid meter, meaning that they may only consume electricity paid for in advance by purchasing electricity credit. In Ghana, most pre-paid customers must purchase credit from a local utility office or shop. In Kenya most can purchase credit remotely using mobile money.

Table A1 and Table A2 present summary statistics for the Ghana and Kenya samples respectively and compare these with the broader population in the study areas. The samples are broadly similar to other households based on observable characteristics from nationally-representative surveys.

Figure 1 displays the timeline of study activities. All respondents completed between one and three phone surveys—baseline, midline, and endline—between May and November 2020.

3.2 Electricity transfer WTP elicitation

In Ghana, we used contingent valuation to elicit WTP for electricity credit in the context of the government's pandemic electricity relief program. Respondents were presented with a sequence of hypothetical dichotomous choices to elicit WTP for a GHS 50 (USD 8.60) electricity transfer in each survey round, which is between the median and mean monthly government pandemic relief transfer expected in our sample, and represents 15 days of average electricity spending. Respondents were first asked to choose between a GHS 50 electricity transfer and a cash transfer of the same amount; the cash amount of each subsequent choice depended on the previous response. WTP is the highest cash transfer amount the respondent rejected in favor of the electricity transfer (up to a maximum of GHS 100 and a minimum of GHS 15). This approach is commonly used to elicit WTP for goods or services (Alberini and Cooper 2000), including for electricity in different African

countries (Abdullah and Jeanty 2011; Deutschmann et al. 2021; Sievert and Steinbuks 2020).

Kenya did not have an analogous government electricity transfer program. Instead, we asked 1,092 respondents their WTP for hypothetical transfers. The structure of the non-incentivized decisions mirrors that of Ghana, with a reference electricity transfer of USD 5. In addition, we leverage choices made as part of a randomized controlled trial that involved 2,053 respondents. Those in the treatment groups received three monthly transfers in between the baseline and endline surveys. One-sixth—349 respondents—were given a choice between transfers of USD 5 in electricity tokens or USD 5 in mobile money ('T2A'): we can thus compare their responses with the non-incentivized samples. Among the urban sample, USD 5 represents 50 days of average electricity spending. The remaining treatment assignments are shown below.[2] Figure A1 displays the sample size for each treatment.

> **[C] Control group (33.3%)** Participants are surveyed but did not receive any transfers.
> **[T1] Token transfer (33.3%):** Participants received three transfers of pre-paid electricity tokens valued at USD 5 each.
> **[T2A] Token vs high cash choice (16.7%):** Participants were given a choice between USD 5 worth of electricity tokens or USD 5 in cash, transferred via mobile money. Whichever option they chose, they received each USD 5 transfer three times within a two month period.
> **[T2B] Token vs low cash choice (16.7%):** Participants were given a choice between USD 5 worth of electricity tokens or USD 3.50 in cash, transferred via mobile money. Whichever option they chose, they received each transfer three times within a two month period.

For 70% of respondents, the USD 5 transfer bought around 32 kWh in pre-paid electricity.[3] All experimental transfers were transmitted remotely. Cash was transferred using Safaricom's M-Pesa mobile banking service to a mobile money account tied to a phone number provided by the respondent. Electricity tokens were purchased at a local Kenya Power office, and then the token ID was sent by SMS to respondents, who could then enter it into their meter to activate the credit.[4]

4 Results: Preferences for electricity and mobile money

Table 1 shows the main result: in Ghana, around 50% of respondents choose electricity credits over an equal amount of mobile money, while in Kenya, only 20-25% do. These results are not driven by

[2] To avoid spillover contamination, treatments for the rural sample are randomly assigned at the village level, stratified by the number of respondents in each village and the study each village was originally a part of. Randomization for the urban sample is done at the individual level.

[3] Kenya Power's tariff changes slightly month-to-month. In addition, those connected through the government's Last Mile Connectivity Project (LMCP)—including most respondents from Wolfram et al. (2021) and those not connected through Lee et al. (2020)—were paying monthly installments for their connections. In these cases, part of each top-up is applied to debt repayment before being used to buy kWh of electricity. 15% received around 22kWh, 7% received around 16kWh, and the rest received between 10 and 30 kWh per transfer. Respondents connected through Lee et al. (2020) did not have debt outstanding and generally received around 32 kWh. 32 kWh per month is Kenya's 'lifeline' amount and is roughly equivalent to operating 4 light bulbs, a television, a cell phone charger, and an iron for month under average usage patterns.

[4] To prevent fraud, each token is tied to a respondent's Kenya Power account number.

Table 1: Preference for electricity over cash

	(1)	(2)	(3)
Kenya (=1)	-0.24***	-0.23***	-0.12**
	(0.01)	(0.03)	(0.06)
Rural (=1)		0.01	-0.07
		(0.03)	(0.06)
Incentivized (=1)		-0.18***	-0.29***
		(0.03)	(0.06)
Electricity expenditure in the past week (USD 10s)			0.03**
			(0.01)
Observations	4610	4610	4160
Control Mean	0.49	0.49	0.49

The outcome variable is the fraction of respondents who choose electricity when given a choice between a cash transfer and an electricity transfer of equal value. Standard errors in parentheses.

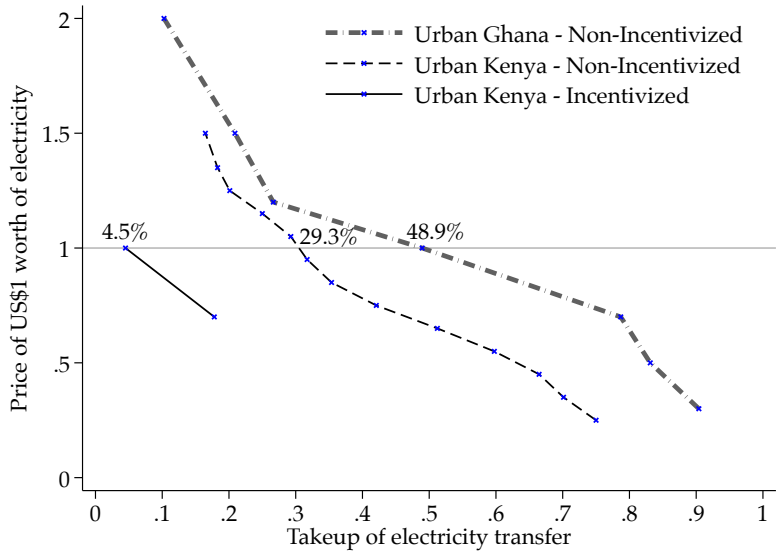
whether the respondent lives in an urban or rural area, nor can they be fully explained by whether the preference was elicited in an incentivized or non-incentivized manner. Controlling for baseline electricity expenditures shrinks the gap, but there remains a sizable and significant difference in preferences between Kenya and Ghana. In Kenya, urban households overwhelmingly prefer mobile money, and are willing to forego on average 40% of value to receive mobile money instead of an electricity transfer. By contrast, in Ghana, respondents are on average willing to forego 4% of value to receive an electricity transfer instead of mobile money.

Figure 2 shows the main result graphically, showing take-up of electricity at different implicit prices of electricity (the ratio of the mobile money offer to the electricity transfer offer). In the Kenya experimental sample, when the implicit price of USD 1 of electricity is USD 1 of mobile money, 5% of urban participants take up the electricity transfer (choosing USD 5 in electricity over USD 5 in mobile money). Even when USD 1 of electricity has an implicit price of only USD 0.70 in mobile money, only 18% select electricity. This incentivized preference for cash is only slightly lower among rural respondents (Figure A2). For the sub-sample of urban households that were presented with hypothetical choices between electricity and mobile money, 29% chose electricity. In Ghana, on the other hand, almost half of respondents choose electricity at an implicit price of USD 1.[5]

Although previous work has shown that hypothetical elicitation of WTP may be upward-biased compared to incentivized elicitation (Loomis 2011), including for demand for electricity connections in Kenya (Lee et al. 2020), differences in WTP elicitation techniques cannot fully explain the measured gap. WTP for electricity for the non-incentivized group is higher than for the incentivized group in urban Kenya, but it remains considerably lower than in urban Ghana. Table 1 confirms that respondents in Kenya are much less likely to choose electricity over mobile money than respondents

[5]Responses in Ghana are similar across survey rounds and among respondents that had and had not received government electricity relief (Figure A3).

Figure 2: Demand for Electricity Transfers by Context and Incentivization



Demand for USD 1 of electricity expressed in USD of mobile money. The horizontal line represents the point where USD 1 of electricity costs USD 1 in mobile money. The numbers shown indicate the share of respondents who prefer electricity to mobile money in an equal trade-off, by context. Solid lines indicate incentivized elicitation, where transfers that respondents receive depend on their responses. Dashed lines indicate non-incentivized elicitation, where respondents indicate preferences over hypothetical tradeoffs between electricity and cash transfers.

in Ghana even after controlling for whether their response is incentivized.

If the gap in preferences is not driven by WTP elicitation techniques, what contextual differences between Ghana and Kenya might explain it? Prices cannot be driving the greater preference in Ghana for electricity, since electricity is cheaper in Ghana—for a total purchase of USD 5, one kWh costs only USD 0.09 in Ghana but USD 0.16 in Kenya.[6] Table A3 compares nationally-representative economic statistics for urban Ghana and urban Kenya from the 2014 Demographic and Health Surveys. Households in Ghana are slightly more likely to be connected to electricity, but this gap has closed recently: by 2019, 94% and 91% of urban households in Ghana and Kenya had access to electricity (World Bank 2019). Most other variables—including radio ownership, mobile phone ownership, bicycle and motorcycle ownership, household size, and education—are very similar across urban Ghana and urban Kenya.[7]

Although urban Kenya and Ghana are generally similar, there are three potential contextual differences that might drive the preferences gap: differences in electricity expenditure, past experiences with government electricity transfers, and different mobile money infrastructure. First, electricity spending is higher in Ghana. Table A3 shows that urban households in Ghana are more likely to own large appliances than those in Kenya, and Table A1 and Table A2 show that monthly electricity spending is five times as high in Accra, Ghana as in urban Kenya, at USD 15 and USD 3.20

[6]Since tariffs are a non-linear function of fixed and variable charges, cost per kWh differs per person. The reported figures are sample average rates for a USD 5 purchase, which buys around 58 kWh in Ghana, but only 32 kWh in Kenya.

[7]Electrification, appliance ownership, and education are uniformly lower in rural areas of Kenya.

per month, respectively. To rule out that Ghanaians prefer electricity to cash simply because they spend more on electricity, Figure A4 shows the correlation between preference for mobile money and monthly electricity expenditures for each country. Preferences are relatively constant regardless of electricity expenditure, and, crucially, the difference between Kenya and Ghana holds even when comparing respondents with relatively similar electricity expenditures.

Second, respondents in Ghana might have trusted the implementation of a hypothetical electricity transfer more than a mobile money transfer given their past experience with Ghana's pandemic electricity relief program. However, it does not appear that this is an important channel. Just 6% of those who preferred electricity cited a lack of trust that they would actually receive the mobile money transfer as a reason. Respondents who received at least one government electricity transfer are slightly more likely to opt for electricity, but this difference is less than 5% and only marginally significant at the 10% significance level.

Having ruled out these other explanations, we argue that the difference in mobile money infrastructure is the most likely explanation for the gap in preferences for electricity versus mobile money transfers between Ghana and Kenya. Kenya has a well-developed and widely adopted mobile money system in M-PESA, making mobile money transfers much more attractive than electricity transfers; by contrast, Ghana lags in mobile money adoption, making electricity transfers preferable. In Kenya, 97% of households regularly use a mobile money account (Suri et al. 2021), compared to 39% in Ghana (Bank of Ghana 2019). In Ghana, mobile money has high transaction fees—10% of respondents in Ghana state that they "worry about mobile money charges/costs"—and is not widely accepted by merchants, decreasing its value. By contrast, in Kenya, mobile money can purchase a broad set of goods and services. Differences in mobile money infrastructure also affect transaction costs of electricity purchases. In Ghana, 21% of respondents who preferred electricity state that it "takes too much time/effort to top up," while in Kenya only 10% of respondents report the same. Most Kenyan households can use mobile money to purchase electricity credits through Lipa-na-MPESA, while Ghanaian households must go to an official vendor. Lipa-na-MPESA penetration is lower in rural Kenya, lowering the value of mobile money and its increasing transaction costs, which may explain the gap between urban and rural preferences seen in Figure A2.

The results suggest that the optimal form of government transfers (mobile money or electricity credits) depends on a country's financial transactions infrastructure. However, that landscape is rapidly changing. While mobile money is still less widely used in Ghana than in Kenya, Ghanaians are rapidly adopting mobile money. Between December 2017 and December 2018 the number of active mobile money accounts increased by 17%—from 11 million to 13 million—and the number of mobile money agents more than doubled—from 195,000 to almost 400,000 (Bank of Ghana 2019). If Ghana reaches the high levels of mobile money adoption seen in Kenya, household preferences for electricity versus mobile money may shift, and make mobile money transfers a more desirable way to disburse government aid. The COVID-19 pandemic has accelerated the adoption of mobile money and financial products in many countries (GSM Association 2021), likely hastening this transition.

At the same time, mobile money penetration may remain persistently low in some communities—

including those with low financial literacy, those where intended recipients are too poor or lack the technological know-how to own a cellphone, and the ultra-poor, for whom mobile banking fees can be prohibitive. In these contexts, in-kind transfers may remain preferred.

In addition to contextual factors, differences at the individual level can explain some of the variation in preferences. Table A4 explores correlates of preference for electricity over an equal amount of mobile money by context. In Ghana, respondents with many appliance types, and who experienced fewer outage hours in the past month, were also more likely to choose electricity. Appliance ownership—of a refrigerator in particular—is positively associated with a preference for electricity in Kenya as well.

Individuals with sophisticated present-biased consumption preferences may opt to constrain themselves by allocating more resources to electricity credit: pre-paid electricity generally does not expire and can thus be a useful savings device. Among respondents who preferred electricity, 36% in Ghana and 73% in Kenya state that they worry they "will spend the money on something else." At the same time, households facing tighter short-term liquidity constraints—as during an economic crisis—may prefer mobile money. Since electricity credit cannot generally be converted back to cash, large electricity transfers could take months to consume whereas cash may provide these households with much-needed short-term liquidity. Individuals who prefer electricity to cash appear to be those who do not face major liquidity constraints: 62% of respondents in Ghana and 46% of those in Kenya who prefer electricity state that they "would use the money for electricity anyway." For these households, electricity is the marginal expenditure.

5 Results: Impact of transfers

To estimate the impacts of electricity transfers, in Kenya we use the randomized treatments to establish causality, and in Ghana we leverage quasi-randomness in government transfer rollout. In both settings, transfer amounts are relatively small, and we generally estimate minimal impacts.

The following equation estimates the effects of each randomly assigned treatment for the Kenya experimental sample:

$$y_{si} = \beta_0 + \beta_1 T^1_{si} + \beta_2 T^{2A}_{si} + \beta_3 T^{2B}_{si} + X_{si}\Gamma + \varepsilon_{si} \tag{1}$$

where y_{si} is the outcome of interest for respondent i at village s, $T^1_{si} = 1$ if the respondent is assigned to the direct electricity transfer arm (T1), $T^{2A}_{si} = 1$ for the USD 5 electricity / USD 5 cash arm (T2A), $T^{2B}_{si} = 1$ for the USD 5 electricity / USD 3.50 cash arm (T2B), and X_{si} is a vector of controls, pre-specified in Berkouwer et al. (2020). ε_{si} are clustered by village for the rural sample but allowed to vary by individual for the urban sample. Panel A of Table 2 estimates equation 1 for the urban sample.[8] Panel B estimates equation 1 for the rural sample, pooling survey rounds 2

[8] As a newly collected sample recruited over SMS, the urban data lack the same detailed set of outcomes as for the REPP and LMCP samples, so the regressions instead include indicator variables for each of the eight Living Standard Measure (LSM) scores as controls.

Table 2: Impact of transfers on energy and other consumption, Kenya

Panel A: Urban Sample

	N	Control Mean (SD)	Token Treatment (SE)	500 Ksh vs Tokens (SE)	350 Ksh vs Tokens (SE)
Electricity usage since baseline (kWh)	651	40.88	42.73***	3.21	9.89*
		(40.06)	(4.32)	(4.10)	(5.20)
Electricity usage since baseline (approx value in USD)	651	3.74	3.91***	0.29	0.91*
		(3.67)	(0.40)	(0.38)	(0.48)
Prepaid electricity expenditure in the past 2 weeks in USD	897	1.39	-0.58***	0.26	0.17
		(1.92)	(0.14)	(0.18)	(0.18)
Meter balance (kWh)	690	10.03	15.48***	-1.43	3.96**
		(13.86)	(1.69)	(1.20)	(1.84)
Energy spending in the past 7 days in USD (excl. electricity)	894	0.72	0.17	0.10	0.12
		(1.66)	(0.14)	(0.17)	(0.16)
Energy spending in the past 7 days in USD (excl. electricity and charcoal)	891	0.17	-0.03	0.05	-0.01
		(0.54)	(0.04)	(0.06)	(0.04)
Non-energy spending in the past 7 days in USD	887	32.89	-1.09	-3.00	-0.69
		(25.66)	(2.01)	(2.38)	(2.39)
Dissaving (pc) in the past 14 days in USD	908	7.17	2.09	3.51	-0.06
		(38.69)	(2.73)	(5.73)	(2.60)
Total consumption in the past 7 days in USD	887	34.32	-0.94	-2.51	-0.30
		(26.35)	(2.08)	(2.46)	(2.44)

Panel B: Rural Sample

	N	Control Mean (SD)	Token Treatment (SE)	500 Ksh vs Tokens (SE)	350 Ksh vs Tokens (SE)
Electricity usage since baseline (kWh)	1305	47.47	28.81***	18.08***	6.10
		(46.29)	(3.62)	(5.63)	(4.60)
Electricity usage since baseline (approx value in USD)	1305	4.35	2.64***	1.66***	0.56
		(4.24)	(0.33)	(0.52)	(0.42)
Prepaid electricity expenditure in the past 2 weeks in USD	1803	1.05	-0.41***	0.06	-0.25**
		(1.49)	(0.09)	(0.13)	(0.11)
Meter balance (kWh)	1413	11.64	12.95***	1.19	7.73***
		(20.88)	(1.56)	(1.84)	(2.11)
Energy spending in the past 7 days in USD (excl. electricity)	1814	0.66	0.31**	-0.21*	0.14
		(1.64)	(0.12)	(0.12)	(0.17)
Energy spending in the past 7 days in USD (excl. electricity and charcoal)	1812	0.48	0.02	-0.03	-0.02
		(1.27)	(0.08)	(0.11)	(0.10)
Non-energy spending in the past 7 days in USD	1847	24.43	3.49**	0.29	0.99
		(23.04)	(1.63)	(1.78)	(2.04)
Dissaving (pc) in the past 14 days in USD	1850	1.86	-1.50	-3.09*	-2.35*
		(24.14)	(1.22)	(1.74)	(1.39)
Total consumption in the past 7 days in USD	1847	25.54	3.73**	0.07	1.04
		(23.82)	(1.71)	(1.84)	(2.13)

Estimates of Equation 1 for energy and consumption outcomes in Kenya. From left to right, the columns show the number of observations, the control mean, and the treatment effects of T1, T2A, and T2B (all relative to control). Regressions include baseline controls for sex, education, banking status, and housing quality (from Lee et al. (2020) or Wolfram et al. (2021)); and the Covid-19 survey baseline value for each outcome. FDR q-values for all coefficients are statistically insignificant at $\alpha = 0.10$, except for electricity usage for T1 (FDR q-value = 0.00). Electricity usage since baseline (kWh) is the sum of (1) the difference between baseline and endline meter balance, (2) household top-ups since baseline, (3) kWh received through treatment (if any).

and 3 to increase statistical power.

In Ghana we leverage quasi-random variation in respondent receipt of the government's pandemic electricity relief program to estimate these effects. Berkouwer et al. (2021) describes the variation in whether and when households received government electricity relief in more detail. We analyze impacts of government transfer receipt using the following household fixed effects specification:

$$y_{it} = \beta_0 + \beta_1 T_{it}^{30} + \beta_2 T_{it}^{pre-30} + \mu_i + \tau_t + \varepsilon_{it} \tag{2}$$

Table 3: Government relief and energy and other consumption, Ghana

	N	Control Mean (SD)	Relief in last 30 days (SE)	Relief before last 30 days (SE)
Electricity spending in past month (USD)	2312	15.20	-1.49*	-1.32
		(13.49)	(0.83)	(0.98)
Current balance on prepaid meter (USD)	759	5.05	0.23	0.01
		(7.01)	(0.88)	(1.15)
Pre-paid topups in last 30 days	2000	1.90	-0.19*	-0.10
		(1.40)	(0.11)	(0.13)
Average topup amount in last 30 days (USD)	2004	10.21	-0.13	-0.41
		(9.56)	(0.57)	(0.71)
Total consumption in the past 7 days (USD)	2349	113.27	0.18	-0.63
		(110.53)	(6.92)	(8.41)
Energy spending (excl. electricity) in the past 7 days (USD)	2325	4.39	0.09	0.13
		(6.37)	(0.52)	(0.58)
Food spending in the past 7 days (USD)	2329	32.63	0.44	1.82
		(25.97)	(1.69)	(1.84)
Worried about having enough food in past 7 days (=1)	2350	0.22	-0.04	-0.04
		(0.41)	(0.03)	(0.03)
Number of days in past 7 that adults skipped meals	2348	0.86	-0.13	0.02
		(1.88)	(0.12)	(0.13)

Estimates of Equation 2 for energy and consumption outcomes in Ghana. From left to right, the columns show the number of observations, the control mean, and the effects of receiving government electricity relief in the last 30 days and of previously receiving relief but not in the last 30 days (relative to never receiving relief). Timing of transfer receipt is not randomly assigned, so these estimates should be interpreted as suggestive correlations. Regressions include household and week fixed effects, and we cluster SEs at the household level. FDR q-values for all coefficients are statistically insignificant at the $\alpha = 0.10$ level.

where y_{it} is the outcome of interest for respondent i at time t, $T_{it}^{30} = 1$ if the respondent received government relief in the last 30 days, $T_{it}^{pre-30} = 1$ if the respondent previously received government relief but not in the last 30 days, μ_i is a household fixed effect, and τ_t is a week of year fixed effect. Standard errors are clustered at the household level. The coefficient on $T_{it}^{30} = 1$ can be interpreted as the effect of receiving relief relative to never receiving any government electricity transfers. Transfer receipt in this sample is plausibly quasi-random: we do not find any evidence that baseline socioeconomic characteristics predict receipt, and by including household fixed effects we rule out inter-household selection bias. However, since the timing of transfer receipt is not randomly assigned, these results should be interpreted as suggestive. Table 3 presents the results.

While we use different methods for estimating impacts, we find limited impacts of the transfers on socioeconomic outcomes in Kenya and Ghana. Electricity transfers increased electricity usage despite decreased electricity spending in both contexts, which suggests electricity transfers also free up some resources for other uses. The frequency of electricity top-ups also falls in Ghana, indicating lower transaction costs for transfer recipients. Households in rural Kenya that receive electricity transfers significantly increase their total spending in the last 7 days.

In Kenya, electricity transfers increased electricity usage by 29 kWh (worth roughly USD 3) for the rural sample and 43 kWh for the urban sample. These effects are large: relative to the control group, treated households increased electricity usage by 62% in the rural sample and 105% in the urban sample. Transfers also led to higher electricity meter balances at endline for both groups, and to decreases in recent electricity spending. Recipients thus appear to be storing some portion of their transfers, in addition to increasing their consumption.

On the other hand, the T2A treatment arm had no effect on electricity usage among urban

respondents—95% of whom chose mobile money. Given that electricity is storable and transaction costs for using mobile money to purchase electricity tokens are low, there is no reason *ex ante* for the electricity transfers in T1 to generate larger increases in electricity usage. Instead, mental accounting, or increased attention to electricity usage due to the treatment, might account for increased electricity consumption among T1. The T2B treatment arm—when the offered mobile money amount is less than the offered electricity transfer—does increase electricity usage, consistent with more respondents choosing electricity in this treatment.

In Ghana, electricity expenditure falls by USD 1.50 in the last 30 days for respondents that received electricity relief in that time period. This is driven by households receiving electricity relief topping up their electricity credit significantly less frequently; average top-up size does not fall. Electricity transfers thus allow households to avoid transaction costs associated with topping up electricity. Pre-paid meter balance at the time of the survey increases, but unlike in Kenya this is not significant—households appear to be largely consuming rather than storing their transfers. This indicates that monthly relief transfers were generally inframarginal to optimal monthly household electricity consumption, which accords with the transfer program design. The reduction in monthly expenditure is less than the mean amount received in the last 30 days among recipients (10 USD). Together with the non-significant increase in meter balance, this suggests recipients increase electricity consumption relative to non-recipients, with over 75% of the transfer going to increased consumption.

Other than electricity use, electricity transfers had minimal impacts on other outcomes such as non-energy spending and food security in both Kenya and Ghana. Table A5 reports results for additional socio-economic outcomes in Kenya.

In Kenya, we also analyze the treatment impacts when respondents chose between electricity and cash. Since most chose cash, impacts of those treatments can be interpreted as closer to the impact of cash transfers. While the electricity transfer has a significant impact on electricity usage but no other outcomes, the cash transfers have no to little impact on any of the measured outcomes. Given the existing literature finding large positive effects of cash transfers (Haushofer and Shapiro 2016; Handa et al. 2018), the lack of detectable impacts may be the result of limited statistical power, especially considering the modest transfer size. We therefore interpret these results cautiously.

6 Conclusion

How does a country's financial infrastructure affect the optimal government response to an economic crisis? We run preference elicitation surveys in urban Kenya and Ghana where respondents choose between electricity credit and a varying amount of mobile money. These two contexts—urban settings in Sub-Saharan Africa with high rates of electricity connectivity, cell phone ownership, and education—are comparable along most observable characteristics, yet we find strikingly different results. In urban Kenya, 95% of respondents prefer mobile money to the same amount in electricity credit, with most choosing cash even when offered prepaid electricity tokens worth 40% more. In

urban Ghana, on the other hand, nearly half of respondents prefer electricity, and many respondents are willing to forego significant value to receive electricity rather than mobile money.

These differences likely stem from Kenya's advances in mobile money infrastructure. Mobile money is almost ubiquitous in Kenya and is well-integrated with Kenya Power's payment system, increasing its value and reducing the transaction costs of buying electricity. By contrast, in Ghana mobile money is less common, limiting its value, and direct electricity transfers allow recipients to avoid the transaction costs associated with buying prepaid electricity credit.

For governments, mobile money infrastructure provides a channel to transfer funds cheaply and quickly. It may also alleviate financial pressures that electricity subsidies impose on utilities. In theory the mode of transfer should not affect the fiscal source of funding, but in practice, the cost of electricity transfers is often borne by utilities, whereas cash transfer programs are often paid for by other government agencies. This is an important concern. Electric utilities in 37 out of 39 Sub-Saharan African countries are currently operating at a cost that exceeds the revenue recovered through existing tariffs (Kojima and Trimble 2016). In contexts where utilities are majority government-owned, they may receive a mandate of providing subsidized electricity without financial compensation for the additional cost this would incur. This added social responsibility may increase financial strain on a utility's ability to provide reliable electricity. Fiscal and financial responsibilities will vary by context and may also affect optimal policy.

Together, these results demonstrate that financial infrastructure affects the efficiency of government aid disbursement and a social planner's optimal policy choice. In contexts with rapid mobile money adoption, cash transfers will likely become a cheaper and more effective channel of disbursing government aid, as shown by the expansion of social assistance in some African settings during the pandemic (Gentilini et al. 2021a; GSM Association 2021). However, in contexts with limited mobile money adoption but a more developed utility infrastructure, in-kind transfers may continue to be preferred. Governments responding to economic crises, including the ongoing COVID-19 pandemic, should adapt policies to reflect the level of mobile money adoption and its integration with payment systems.

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