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Electricity Access in non-OECD Countries: Do Household Size and Composition Matter?*

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Abstract: *Despite considerable improvements in electricity coverage, millions of people are still lacking the access to electricity. Residential electricity access is a prerequisite for numerous aspects of increased well-being and quality of life. The aim of this paper is to identify key household characteristics that are linked to the energy poverty measured as access to electricity. Literature on financial and general poverty showed mixed results on household size and characteristics as a driver of poverty. We argue that household size and proportion of children in households are key variables associated with energy poverty in developing countries with lowest levels of electricity coverage. Our research approach treats electricity access as economic good and focuses on demand side – households. By utilizing census microdata across 69 non-OECD countries, our research provides large-scale analysis on household size and characteristics as a driver of energy poverty. We found that, in majority of low-income countries, same principles for general or financial poverty apply to energy poverty which is represented by negative effect of household size and proportion of children on energy poverty.*

Keywords: electricity access; household size; energy poverty; demographic change

JEL Classification: J1, Q40

Introduction

Access to electricity is a prerequisite for a number of activities that significantly raise the quality of life and prevent general poverty (Pachauri & Spreng, 2003). Despite tremendous expansion of electricity network in recent decades in many developing countries, almost 20% of the world population does not yet have the access to electricity (Panos et al., 2016). Majority of non-electrified households are located in

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Sub-Saharan Africa with 578 million people without access to electricity (International Energy Agency, 2020).

Demographic changes play an important role in electrification success. For example, rapid population growth in Sub-Saharan Africa slowed down or even reversed improvements in electricity access measured by share of people with access to electricity (Pachauri et al., 2012). Also, changes in household formation and type could result in significant increase in demand for new connections. Developing countries are characterized mainly by young age structure. Changes in the household formation towards increased preference for nuclear families or leaving parental household in general creates a great demand for new connections to the electrical grid as shown in South Africa (Wittenberg et al., 2017). Evidence from developed countries shows increased residential electricity consumption for younger (Liddle, 2011) and older cohorts (Estiri & Zagheni, 2019; Liddle, 2011). The same is not yet confirmed for developing countries, but due to their young population structure it could prove to be another obstacle in gaining universal electricity access.

In the research on residential energy consumption emphasis is put on building characteristics, which is confirmed to be important physical factor of energy consumption. However, the building characteristics alone do not explain the differences in household energy consumption, moreover, there are differences among households with similar building characteristics. Broader understanding of household energy consumption lacks demographic background because existing research connecting these topics show that households have an indirect impact on energy consumption (Estiri, 2015; Estiri & Zagheni, 2019).

Access to electricity is a prerequisite to electricity consumption and we argue that some concepts valid for energy consumption apply to access to electricity. However, energy consumption represents the "demand-side" yet access to electricity is dependent on the "supply side" since it usually relies on infrastructural projects funded by national authorities or large-scale private investments. Large-scale infrastructure projects on electrification have effectively improved electricity coverage in urban areas in developing countries. However, no similar progress has been made in rural settlements where electrification expansion stalled. In recent decades, new technological solutions have enabled new, innovative methods of creating a decentralized energy system. Such systems have been developed precisely with the aim of increasing electric coverage in rural settlements in developing countries. Literature does not identify ideal approach for rural electrification. Rather, multiple approaches are suggested, particularly since off-grid systems needed for large-scale rural electrification are often not commercially viable option (Alstone et al., 2015; Chaurey et al., 2004). Public financing of electrification, however unpopular for various reasons, must not be written off in underdeveloped countries, with particular emphasis on sub-Saharan Africa, where the spread of electricity coverage is particularly challenging (Chaurey et al., 2004; Onyeji et al., 2012).

In the case of developing countries, the access to electricity is rather an issue of infrastructural development, not the household choice. Therefore, in our research the theoretical framework of access to electricity is based on the concepts of energy inequality or energy poverty. This concept treats residential access to electricity as a social phenomenon, rather than pure market lack of supply, and views it in terms of poverty, exclusion or inequality.

Energy inequality is well represented in existing literature. The concept of energy poverty and human interaction measured through demographic processes is still lacking the broad empirical evidence (Pachauri & Spreng, 2003, 2011). On the contrary, the effect of demographic change, mostly ageing, on energy consumption in developed countries is well covered. Issues present in developing countries like rapid urbanization, change in household size and structure and population growth are lacking research that connects them to consumption or more specific sub-types like energy consumption. Our aim is to widen existing knowledge on energy poverty from the demographic perspective. Rapid urbanization in developing countries led to new issues regarding urban infrastructure, most commonly viewed through inadequate access to services and slum formation (Ooi & Phua, 2007).

In our research, we focus on two research questions:

1. Are larger households more prone to energy poverty?
2. What is the impact of household type and composition on energy poverty?

In general, energy poverty can be treated as a form of poverty. Existing literature on various aspects and measurements of poverty deal with household size and household type or composition as a driver of poverty. However, the results vary by country, time and methodology.

Some findings suggest that larger households or households with high proportion of children are positively correlated with poverty (Fusco & Islam, 2020; Meyer & Nishimwe-Niyimbanira, 2016; Rakodi, 1995; Woolard & Klasen, 2005), especially in developing countries, and that view has influenced research and policy (Lanjouw & Ravallion, 1995). Also, research is divided on the core root of link between poverty and household size (whether poverty is the "cause" or the "consequence" of large households).

On the other hand, some studies do not support that view. For instance, when accounted for various other phenomena, such as elasticity, the effect of household size on poverty vanishes or the results do not provide clear answer (Lanjouw & Ravallion, 1995; Orbeta, 2005).

Data and methods

Since our goal is to study the effect of household size and composition on access to electricity as a measure of energy poverty, we used a data source that utilizes both variables. Various data sources and institutions provide information on residential

access to electricity. For instance, World Bank or International Energy Agency (IEA) datasets are widely used as a standard for estimates on electricity coverage in developing countries. They differ in methodology, where World Bank in their Tracking SDG7 Report uses surveys and IEA in its estimates uses data from national governments (usually Ministries of Energy). However, those datasets are available only as aggregates, rather than microdata (individual or household level). On the other hand, national population censuses included the question on electricity access. We found census microdata (individual and household level census data) to be a viable data source for this research. Therefore, we used census microdata from The Integrated Public Use Microdata Series-International (IPUMS-International) project. IPUMS-I data consists of integrated and harmonized census microdata that allow cross-temporal and cross-sectional comparability (Sobek et al., 2011).

Our dataset consists of 228 different samples from 75 non-OECD countries represented in IPUMS-I project from the period 1970-2014. Of those, final 69 samples that represent last available census round were used for models. We used only harmonized set of variables and used provided person and household weights in our analysis.

We have measured energy poverty as household's electricity access. Therefore, our primary variable of interest was variable "ELECTRIC" which indicates whether the household had access to electricity. Since our aim was to identify the key aspects of access to electricity regarding urban status and household type we focused only on private households (for filtering our samples on private households we used variable "GQ" which represents "group quarters" and divides household units on type: households, group quarters or vacant units) and left out various types of institutional or grouped living arrangements.

Since access to electricity is a household-level variable, we were limited in studying the effects of individual-level sociodemographic variables on access to electricity such as age, sex and education. In comparable research on consumption, one could mitigate this issue by studying single households (Raty & Carlsson-Kanyama, 2009). In that case, all individual-level variables apply to the household-level and vice versa. However, this approach has its own caveats and limitations and cannot be considered as a fully adequate method for understanding the effect of age, sex and education and other individual-level characteristics on access to services.

Therefore, we limited our research on household level variables. Our focus of interest was set on three original IPUMS-I variables: urban-rural type of settlement in which household is placed, household size measured by number of household members and household type (one-person household, married couple with children, extended family, non-relative household etc.). Also, we were interested in one derived variable: proportion of children in household, since that variable proved to be important in studying general or financial poverty (Lanjouw & Ravallion, 1995).

We used binomial logistic regression models for every country with household's access to electricity as a binary dependent variable. Binomial logistic regression pre-

dicts the probability of an observation getting one of the two possible values (categories) of the dependent variable. In our case the dependent variable was access to electricity and its categories were "does not have the access to electricity" and "does have the access to electricity". The level of observation was household.

Predictor variables consist of household size, household type and proportion of children in household. We have begun with simple Model 1 which included only one predictor variable: household size (number of persons living in household). We have used the logarithm value of household size. In the Model 2, along with household size, we added other variables of interest: proportion of children in household and household type. The modalities of household type variables presented in our dataset are: "Composite household", "Extended family, relatives only", "Married/cohabitating couple with children", "Married/cohabitating couple, no children", "Non-family household", "Single-parent family", "Polygamous family" and reference modality "One person household".

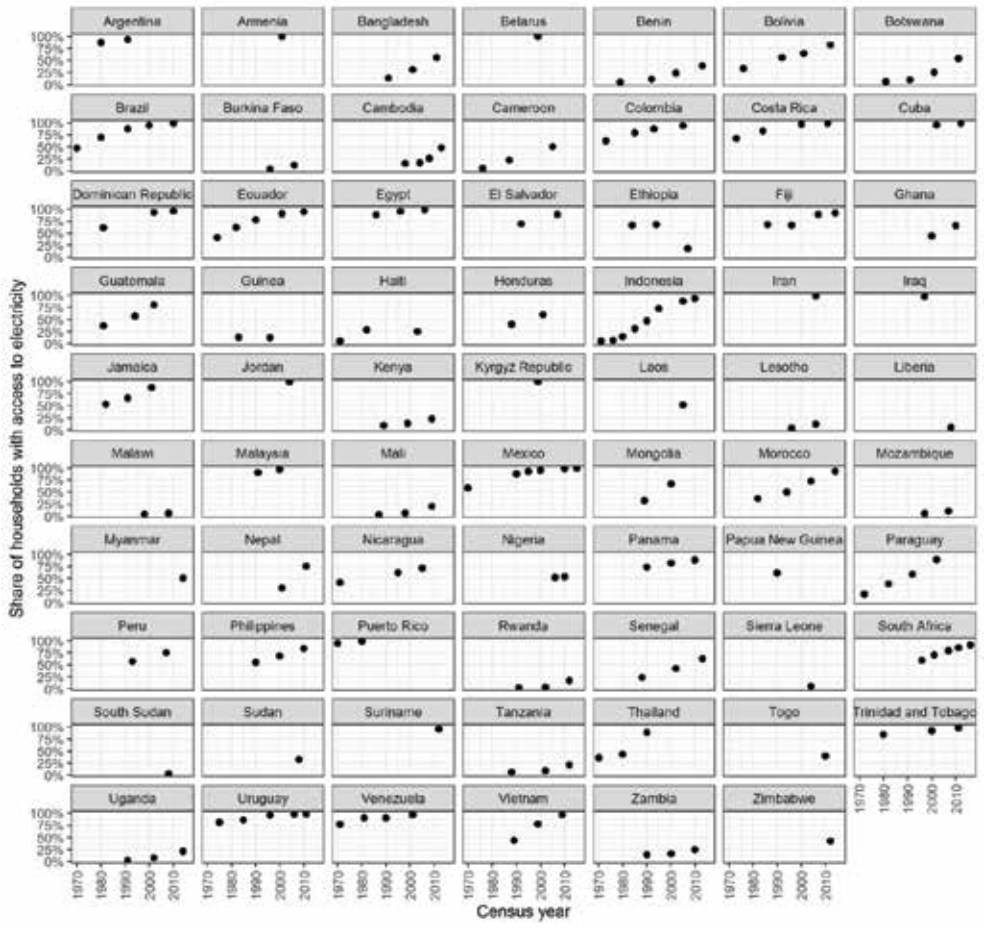
Our models were based on last census round available for each non-OECD country. Finally, we fitted two models on 69 different countries (samples) with a total of 4,685 million observations. For majority of countries, the last available census round was in 2000s.

Results

Although we included all available non-OECD countries, we will focus our discussion on those countries with lower levels of electricity access and those with pronounced inequalities. As mentioned, some developing countries witnessed rapid improvements in electrification. Some developing countries are even witnessing universal access to electricity. However, in pooled data, latest available census samples show that 21,06% of private households still do not have access to electricity.

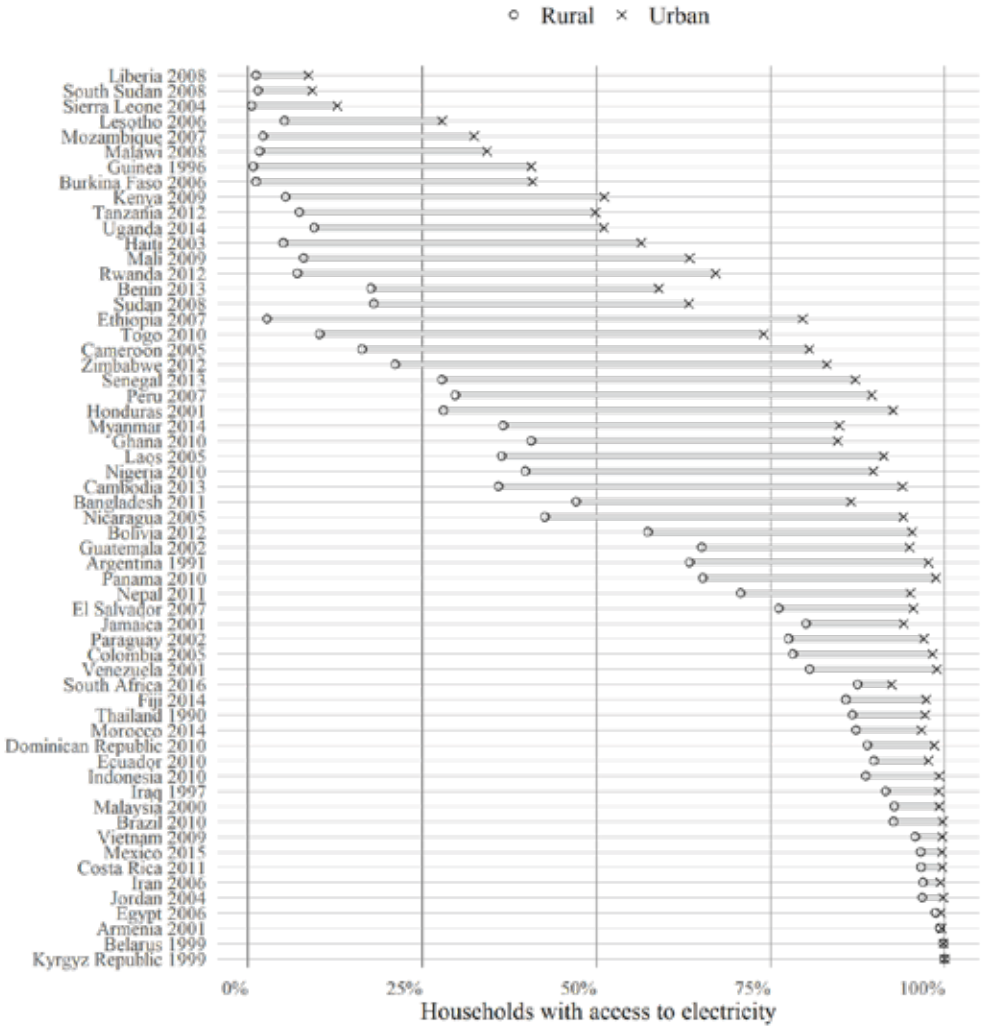
Following figure shows development of electrification among selected countries since 1970. Also, it shows the countries and censuses represented in IPUMS-I database. Some countries (Brazil, Indonesia, Mexico, South Africa, Uruguay) are represented with multiple censuses while some are represented with only one (Armenia, Belarus, Iran, Iraq, Jordan and others). In majority of countries in which we do have multiple samples (censuses), we can see improvement between censuses. However, some countries, like Ethiopia, Guinea, Haiti or Nigeria showed stagnation or decline in electricity access.

Figure 1: Share of households with access to electricity - all available samples since 1970



Urbanization played a significant role in improvement of living conditions and increasing GDP. The same is true for reducing energy poverty. With the exception of few samples, like Kyrgyz Republic, where electricity access is virtually universal, there is a significant difference between electricity access in rural and urban areas. As expected, urban areas had higher share of households with the access to electricity, no matter the general rate of electrification in countries. The following is illustrated in Figure 2. where the x-axis represents the share of households having access to electricity in a country for rural and urban settlements.

Figure 2: Household-weighted mean access to electricity - rural vs. urban



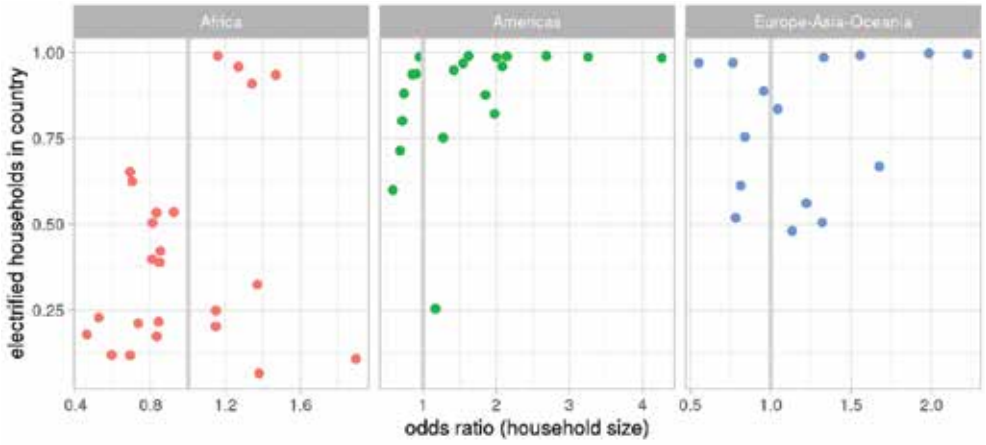
To address our research questions, we formed 2 models, fitted to each sample. The preliminary results are given in Table 1. in Appendix.

In all models, dependent variable was access to electricity as a binary variable. All variables were household-level variables.

Model 1 used logarithm value of household size as an independent variable. In majority of countries, it was a significant variable, however with no clear conclusion on sign of the effect. Many countries showed negative effect, yet many of them showed positive effect. However, when we took country aggregate level electrifica-

tion, a pattern emerged: there is a negative effect of household size on access to electricity in countries with low aggregate electrification rates (virtually majority of Sub-Saharan Africa samples). Different effects of rural population size, density and other variables between Sub-Saharan Africa (SSA) and other developing countries has been found (Onyeji et al., 2012), which goes in line with our descriptive pattern of SSA countries. In countries with high or near-universal electrification rates, the relationship between household size and access to electricity is mixed. The following is illustrated in Figure 3.

Figure 3: Odds ratio and country aggregate electrification rate



Model 2 combines remaining variables. Addition of new variables on household type or composition alleviates the power of household size and explains the effect through composition. As seen in comparable research, we used proportion of children as a measure of household composition. In that context, proportion of children proved to be a good predictor of energy poverty with unanimously negative effect among our samples. Following that finding, we expected to show that household type also gives an additional explanation of that effect, yet the results are mixed. There is no clear conclusion on impact of household type on access to electricity (model 2). Full model results are presented in Appendix. We need more evidence on how (or whether) household type impacts energy poverty.

Limitations

In our research we recognize some methodological and practical limitations. First, we assume that access to electricity is economic good (product or service that has

utility) and apply basic economic rationale. From an economic view, we studied the effect of consumer's characteristics on the demand side for this product. However, electricity is remarkably affected with its supply side – electricity infrastructure. For example, when certain household does express high demand for electricity access and does have means to fund it, it cannot achieve that access without local electric infrastructure. That is especially true for period analyzed in this paper (mainly early 2000 and 2010 census rounds) when self-contained residential energy solutions (e.g. solar panels) were not widely available and affordable, especially in developing countries. In this paper, we focused on demand side, yet supply side of electricity is extremely important in understanding residential electricity access, especially in rural areas.

Second, we studied electricity access as a binary variable as it is presented in our data source. Huge body of literature does the same as well as policy papers and national energy policy strategies. In addition to the access to electricity itself, it is extremely important to take into account the quality of energy supply. We have treated households without access to electricity as energy-poor households, but in the real world, the quality of energy supply is equally important. For instance, hours-long power outages or interruptions are daily events in numerous parts of the world. Namely, the frequency and prevalence of power outages are such that they significantly reduce the levels of economic activity, growth and everyday life in many developing countries (Andersen & Dalgaard, 2013; Cole et al., 2018). Our data source does not reflect the quality of electricity access and therefore we do not address for this issue.

Lastly, we stress out that this analysis should be taken with caution regarding the temporal aspect since improvements in electrification in recent decades had a rapid pace in some parts of the world. This is best illustrated through impressive improvement in Latin America. Latest data shows that just a few countries in Latin America do not have universal access to electricity (World Bank, 2021). However, our results on energy inequality based on household characteristics magnify the necessity for research on demographic aspects of ongoing and future energy policies.

Conclusion

This research started with a demographic background and data source but dealt with economic aspects of energy poverty and energy exclusion, a combination limited in literature. Given the rise in importance and recognition of demographic aspects of various economic phenomena, we expect that similar studies will be conducted in near future, widening the knowledge of this important and applicable field of research. We believe that census microdata, and specially IPUMS dataset is a valuable and useful source of data for this issue. Our results suggest that findings for general or financial poverty apply to energy poverty, as measured by electricity access. Although results on household size were mixed based on sample (country), they are rel-

atively consistent for countries with lowest levels of electrification and show negative impact of household size on electricity access. The same is shown for proportion of children in household, however, with clear results across samples. We showed that uniform pattern does not exist among developing countries. General level of electrification could be the major "macro" variable that makes difference among countries, yet we need more proof for this. Geographical location and related developmental similarities point out specifics of Sub-Saharan Africa, as shown in our, and some other studies on this topic. Further research is recommended, especially in light of continuous population growth in countries with already weak electric coverage. We also recommend supply-side studies and orientation not only on access but also on the quality of the electricity network.

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Appendix

Table 1: Model coefficients (dependent variable - access to electricity)

Sample	Model 1	Model 2								
				Household type (ref. „One person household“)						
	Log PERSONS	Log PERSONS	Proportion children	Composite household	Extended family, relatives only	Married/ cohab with children	Married/ cohab couple, no children	Non-family h.	Single-parent family	Polygamous family
Argentina 1991	-0.158*** (0.0226)	-0.411*** (0.05)	-1.8*** (0.0811)	1.32*** (0.107)	1.35*** (0.0826)	1.88*** (0.0752)	1.4*** (0.0694)	0.255* (0.112)	1.26*** (0.0714)	
Armenia 2001	0.8*** (0.216)	0.476 (0.77)	-0.592 (0.777)	12.4 (596)	1.82 (1.37)	0.0855 (1.09)	0.0374 (0.76)	12.7 (1,056)	-0.268 (0.808)	
Bangladesh 2011	0.2*** (0.00755)	0.311*** (0.013)	-1.33*** (0.0214)	1.08*** (0.0375)	0.456*** (0.0288)	0.32*** (0.0265)	0.111*** (0.0256)	1.77*** (0.0824)	0.493*** (0.0271)	0.133* (0.0527)
Belarus 1999	0.685** (0.209)	3.28*** (0.988)	-4.26*** (0.898)	10.7 (535)	-1.39 (1.15)	-2.28. (1.17)	-1.08 (0.808)	-4.43*** (0.933)	0.0345 (0.882)	
Benin 2013	-0.165*** (0.0231)	-0.271*** (0.0441)	-0.935*** (0.0939)	1.48*** (0.119)	0.793*** (0.0875)	0.583*** (0.0848)	0.127 (0.0976)	1.02*** (0.201)	0.223** (0.0846)	
Bolivia 2012	0.681*** (0.0242)	0.392*** (0.0569)	-0.619*** (0.0779)	0.419*** (0.124)	0.705*** (0.0893)	0.848*** (0.0916)	0.507*** (0.0832)	0.551*** (0.162)	0.484*** (0.0748)	
Botswana 2011	-0.0803** (0.0284)	-0.0276 (0.0654)	-1.23*** (0.13)	0.511*** (0.145)	0.372*** (0.104)	0.787*** (0.112)	0.148 (0.108)	0.271. (0.146)	0.578*** (0.102)	
Brazil 2010	-0.0533** (0.018)	-1.02*** (0.0382)	-1.42*** (0.0595)	2.36*** (0.0984)	2.59*** (0.0662)	2.45*** (0.057)	1.4*** (0.0442)	1.37*** (0.117)	2.4*** (0.0589)	
Burkina Faso 2006	-0.525*** (0.0304)	-0.0637 (0.058)	-2.63*** (0.135)	0.959*** (0.134)	0.0164 (0.113)	-0.271** (0.105)	-1.43*** (0.119)	0.286 (0.206)	-0.158 (0.133)	-1.28*** (0.17)
Cambodia 2013	0.125*** (0.0263)	0.142*** (0.0387)	-1.29*** (0.0632)	2.54*** (0.261)	0.513*** (0.103)	0.359*** (0.0979)	0.0456 (0.0984)	2.25*** (0.626)	0.24* (0.0992)	
Cameroon 2005	-0.211*** (0.0152)	-0.04 (0.0304)	-1.41*** (0.0636)	0.58*** (0.0826)	0.651*** (0.0588)	0.222*** (0.0579)	-0.499*** (0.0632)	0.394*** (0.114)	0.228*** (0.0597)	-1.33*** (0.109)

Sample	Model 1	Model 2								
				Household type (ref. „One person household“)						
	Log PERSONS	Log PERSONS	Proportion children	Composite household	Extended family, relatives only	Married/ cohab with children	Married/ cohab couple, no children	Non-family h.	Single-parent family	Polygamous family
Colombia 2005	-0.102*** (0.0165)	-0.483*** (0.036)	-1.5*** (0.0596)	1.41*** (0.0738)	1.59*** (0.064)	1.52*** (0.0573)	0.705*** (0.0505)	0.694*** (0.105)	1.47*** (0.0557)	
Costa Rica 2011	0.763*** (0.142)	0.305 (0.391)	-2.76*** (0.58)	1.26 (0.788)	1.65** (0.612)	1.84*** (0.542)	0.801* (0.399)	1.06 (1.06)	2.04*** (0.497)	
Cuba 2012	0.696*** (0.0784)	0.631* (0.259)	-0.661* (0.318)	0.298 (0.554)	0.517 (0.342)	0.0171 (0.324)	-0.0184 (0.225)	-1.27** (0.447)	0.453. (0.254)	
Dominican Republic 2010	0.734*** (0.052)	0.0113 (0.133)	-0.801*** (0.206)	0.751** (0.271)	1.42*** (0.206)	1.67*** (0.202)	1.1*** (0.161)	-0.387 (0.254)	1.92*** (0.192)	
Ecuador 2010	0.35*** (0.0376)	0.158. (0.0894)	-2.1*** (0.142)	1.32*** (0.203)	1.32*** (0.147)	1.26*** (0.136)	0.422*** (0.114)	0.364 (0.312)	1.31*** (0.125)	
Egypt 2006	0.147** (0.0458)	-0.22* (0.0913)	-0.717*** (0.129)	2.01** (0.726)	1.17*** (0.182)	1.27*** (0.157)	0.881*** (0.127)	2.25* (1.01)	1.12*** (0.155)	0.471 (0.383)
El Salvador 2007	-0.0407 (0.0485)	-0.468*** (0.0924)	-1.36*** (0.154)	2.34*** (0.273)	1.84*** (0.171)	1.56*** (0.158)	0.788*** (0.146)	1.74** (0.608)	1.56*** (0.152)	
Ethiopia 2007	-0.778*** (0.0263)	-0.32*** (0.0529)	-1.89*** (0.0934)	1.3*** (0.112)	0.427*** (0.0878)	-0.443*** (0.0934)	-0.882*** (0.0918)	1.64*** (0.144)	0.0513 (0.0873)	
Fiji 2014	0.0967 (0.0642)	0.286* (0.13)	-1.82*** (0.215)	1.72. (1.04)	0.472. (0.25)	0.358 (0.225)	-0.0848 (0.198)	1.08 (0.743)	0.541* (0.244)	
Ghana 2010	-0.371*** (0.0127)	-0.405*** (0.0246)	-0.902*** (0.0522)	1.09*** (0.0703)	0.523*** (0.0473)	0.532*** (0.0469)	0.247*** (0.0559)	0.842*** (0.101)	0.589*** (0.0453)	
Guatemala 2002	-0.335*** (0.0319)	-0.295*** (0.0549)	-1.36*** (0.0983)	1.64*** (0.165)	1.02*** (0.123)	0.943*** (0.114)	0.263* (0.115)	1.65*** (0.472)	1.24*** (0.119)	
Guinea 1996	-0.0325 (0.0424)	0.262*** (0.0705)	-1.42*** (0.185)	-0.128 (0.192)	-0.362* (0.167)	-0.576*** (0.165)	-0.762*** (0.197)	0.331 (0.315)	-0.787*** (0.211)	-1.72*** (0.238)

Sample	Model 1	Model 2								
				Household type (ref. „One person household“)						
	Log PERSONS	Log PERSONS	Proportion children	Composite household	Extended family, relatives only	Married/ cohab with children	Married/ cohab couple, no children	Non-family h.	Single-parent family	Polygamous family
Haiti 2003	0.158*** (0.028)	0.214*** (0.0473)	-1.43*** (0.0904)	1.14*** (0.113)	0.645*** (0.0972)	-0.131 (0.102)	-0.347** (0.109)	0.823*** (0.167)	0.374*** (0.0991)	
Honduras 2001	-0.534*** (0.0356)	-0.649*** (0.0591)	-1.31*** (0.112)	2.02*** (0.161)	1.31*** (0.133)	0.908*** (0.126)	0.215. (0.131)	1.47*** (0.381)	1.19*** (0.131)	
Indonesia 2010	-0.0175. (0.0104)	-0.204*** (0.0211)	-1.62*** (0.0334)	2.19*** (0.0916)	1.12*** (0.0389)	0.933*** (0.0342)	0.25*** (0.0292)	1.91*** (0.123)	0.604*** (0.0343)	
Iran 2006	0.285*** (0.0363)	-0.146* (0.0731)	-1.84*** (0.113)	0.758 (0.525)	1.6*** (0.156)	1.51*** (0.126)	0.415*** (0.0915)	10.3 (90.3)	1.01*** (0.13)	0.68* (0.29)
Iraq 1997	-0.268*** (0.071)	-0.206* (0.102)	-1.4*** (0.215)	0.757 (0.633)	1.2** (0.383)	1.32*** (0.365)	0.308 (0.389)	-1.2 (0.836)	1.33*** (0.394)	0.498 (0.44)
Jamaica 2001	0.616*** (0.0469)	0.137 (0.123)	-0.883*** (0.218)	1.26*** (0.273)	1.16*** (0.19)	1.24*** (0.185)	0.953*** (0.17)	0.614* (0.292)	1.07*** (0.158)	
Jordan 2004	0.442* (0.182)	0.00354 (0.347)	-0.505 (0.608)	14.9 (408)	1.17 (0.772)	1.47* (0.686)	1.08. (0.573)	-0.369 (0.703)	1.45. (0.756)	0.679 (1.26)
Kenya 2009	-0.647*** (0.0115)	-0.998*** (0.0269)	-0.964*** (0.0485)	2.42*** (0.0549)	1.01*** (0.0423)	1.07*** (0.0431)	0.588*** (0.0432)	1.28*** (0.0645)	0.42*** (0.0416)	0.709*** (0.18)
Laos 2005	-0.246*** (0.0465)	0.0695 (0.0689)	-2.21*** (0.128)		0.285 (0.233)	0.423. (0.223)	-0.583* (0.242)		0.598* (0.234)	
Lesotho 2006	-0.37*** (0.0444)	-0.169. (0.0993)	-1.49*** (0.196)	1.07*** (0.197)	-0.274 (0.169)	0.17 (0.166)	-0.58** (0.179)	0.46. (0.265)	-0.221 (0.168)	
Liberia 2008	0.0663 (0.0709)	0.215. (0.114)	-1.5*** (0.257)	0.447 (0.297)	0.334 (0.246)	-0.104 (0.25)	-0.462 (0.312)	0.0876 (0.436)	-0.064 (0.266)	0.227 (0.65)
Malawi 2008	0.321*** (0.0441)	0.628*** (0.0675)	-2.37*** (0.139)	1.58*** (0.171)	0.363* (0.143)	-0.205 (0.141)	-0.905*** (0.164)	1.08*** (0.232)	-0.355* (0.164)	-0.863 (0.737)

Sample	Model 1	Model 2								
				Household type (ref. „One person household“)						
	Log PERSONS	Log PERSONS	Proportion children	Composite household	Extended family, relatives only	Married/ cohab with children	Married/ cohab couple, no children	Non-family h.	Single-parent family	Polygamous family
Malaysia 2000	0.0485 (0.048)	-0.0343 (0.0957)	-1.65*** (0.162)	2.6*** (0.417)	0.947*** (0.183)	1.23*** (0.166)	0.477** (0.149)	0.685** (0.218)	0.822*** (0.177)	
Mali 2009	0.137*** (0.0256)	0.305*** (0.0435)	-1.38*** (0.0973)	1.41*** (0.124)	-0.286** (0.105)	-0.592*** (0.098)	-0.912*** (0.106)	0.212 (0.237)	-0.626*** (0.116)	-1.07*** (0.129)
Mexico 2015	0.484*** (0.02)	0.0562 (0.0509)	-1.69*** (0.0764)	1.91*** (0.245)	1.64*** (0.0855)	1.48*** (0.0742)	0.744*** (0.0566)	1.84*** (0.307)	1.29*** (0.068)	
Mongolia 2000	0.516*** (0.0409)	0.447*** (0.0728)	-0.1 (0.127)	0.6** (0.201)	0.455** (0.142)	-0.257. (0.135)	-0.284* (0.139)	0.741* (0.298)	0.0494 (0.135)	
Morocco 2014	0.384*** (0.0252)	0.332*** (0.0538)	-1.47*** (0.0861)	1.06*** (0.19)	0.911*** (0.105)	0.682*** (0.091)	0.494*** (0.0826)	0.596*** (0.172)	0.743*** (0.0915)	
Mozambique 2007	0.639*** (0.0271)	1.22*** (0.0439)	-2.53*** (0.0896)	0.524*** (0.118)	-0.148. (0.0898)	-0.733*** (0.088)	-1.21*** (0.0976)	0.365 (0.233)	-0.486*** (0.0924)	-1.57*** (0.256)
Myanmar 2014	0.278*** (0.0118)	0.364*** (0.0201)	-1.54*** (0.0342)	0.953*** (0.0569)	0.383*** (0.0434)	0.0775. (0.0404)	-0.133*** (0.0392)	1.62*** (0.124)	0.0557 (0.0405)	
Nepal 2011	-0.175*** (0.0186)	-0.307*** (0.0322)	-1.58*** (0.0567)	2.61*** (0.248)	1.2*** (0.0721)	1.02*** (0.0664)	0.206** (0.0643)	1.92* (0.749)	1.28*** (0.0671)	
Nicaragua 2005	-0.375*** (0.0411)	-0.459*** (0.0676)	-2.01*** (0.129)	1.82*** (0.19)	1.55*** (0.162)	1.16*** (0.15)	0.225 (0.153)	1.18** (0.378)	1.51*** (0.156)	
Nigeria 2010	-0.186*** (0.0238)	0.138** (0.0536)	-0.589*** (0.0879)	0.416 (0.263)	-0.0656 (0.1)	-0.357*** (0.093)	-0.569*** (0.0824)	0.638 (0.426)	0.0891 (0.0933)	-0.914*** (0.129)
Panama 2010	-0.302*** (0.0529)	-1.07*** (0.114)	-1.85*** (0.195)	2.82*** (0.252)	2.6*** (0.204)	2.63*** (0.181)	1.76*** (0.174)	1.76*** (0.347)	2.3*** (0.177)	
Papua New Guinea 1990	-0.206* (0.0869)	-0.214 (0.157)	1.09** (0.378)	-0.435 (0.444)	-0.691. (0.372)	-1.14** (0.36)	0.119 (0.429)	0.672 (0.556)	-1.38** (0.478)	

Sample	Model 1	Model 2								
				Household type (ref. „One person household“)						
	Log PERSONS	Log PERSONS	Proportion children	Composite household	Extended family, relatives only	Married/ cohab with children	Married/ cohab couple, no children	Non-family h.	Single-parent family	Polygamous family
Paraguay 2002	0.0796 (0.0508)	-0.0625 (0.104)	-2.4*** (0.196)	2.23*** (0.245)	1.71*** (0.195)	1.7*** (0.182)	0.638*** (0.168)	1.37*** (0.415)	1.52*** (0.181)	
Peru 2007	0.242*** (0.0145)	0.135*** (0.031)	-2.17*** (0.0519)	1.72*** (0.0796)	1.18*** (0.0554)	1*** (0.0513)	0.25*** (0.0468)	1.06*** (0.12)	1.24*** (0.0491)	
Philippines 2010	0.0425*** (0.0107)	-0.123*** (0.0197)	-1.37*** (0.0329)	2.16*** (0.0681)	1.34*** (0.0406)	0.888*** (0.0369)	0.23*** (0.0337)	1.66*** (0.123)	0.758*** (0.0383)	
Puerto Rico 1980	1.18*** (0.156)	0.754 (0.492)	-1.91* (0.745)	14.9 (578)	1.54* (0.707)	1.38* (0.671)	1.11* (0.489)	15 (861)	1.54* (0.604)	
Rwanda 2012	-0.184*** (0.0282)	0.296*** (0.0577)	-0.984*** (0.107)	0.599*** (0.111)	-0.92*** (0.102)	-1.1*** (0.103)	-1.02*** (0.107)	1.32*** (0.122)	-1.54*** (0.105)	
Senegal 2013	-0.355*** (0.0249)	0.0835. (0.0436)	-2.5*** (0.112)	0.367** (0.131)	-0.225. (0.115)	-0.129 (0.111)	-0.339* (0.162)	0.399. (0.226)	0.464*** (0.134)	
Sierra Leone 2004	-0.07 (0.0672)	0.275* (0.109)	-1.54*** (0.258)	-0.208 (0.294)	-0.41. (0.244)	-0.726** (0.249)	-0.56* (0.275)	0.344 (0.372)	-0.606* (0.28)	
South Africa 2016	0.293*** (0.0122)	0.254*** (0.0293)	-1.08*** (0.0512)	0.671*** (0.102)	0.48*** (0.0454)	0.567*** (0.0464)	0.191*** (0.0394)	-0.136 (0.0867)	0.387*** (0.0397)	
South Sudan 2008	0.0638 (0.09)	0.437*** (0.131)	-1.1*** (0.249)	-0.714* (0.354)	-0.711* (0.307)	-1.28*** (0.314)	-0.785* (0.382)	-0.281 (0.434)	-1.31*** (0.327)	-0.536 (0.674)
Sudan 2008	0.315*** (0.0212)	0.798*** (0.0301)	-2.06*** (0.055)	-0.972*** (0.0925)	-0.305*** (0.0779)	-1.08*** (0.0757)	-0.997*** (0.0792)	-1.07*** (0.114)	-0.646*** (0.0781)	-1.54*** (0.175)
Suriname 2012	0.238** (0.076)	0.02 (0.181)	-3.04*** (0.308)	1.9*** (0.405)	1.62*** (0.315)	2.02*** (0.294)	0.497* (0.233)	0.884 (0.565)	1.37*** (0.267)	
Tanzania 2012	-0.172*** (0.0121)	-0.0807*** (0.0239)	-1.5*** (0.0477)	1.03*** (0.0496)	0.395*** (0.0431)	0.137** (0.0436)	-0.293*** (0.0456)	0.808*** (0.064)	0.107* (0.0438)	

Sample	Model 1	Model 2								
				Household type (ref. „One person household“)						
	Log PERSONS	Log PERSONS	Proportion children	Composite household	Extended family, relatives only	Married/ cohab with children	Married/ cohab couple, no children	Non-family h.	Single-parent family	Polygamous family
Thailand 1990	-0.0425* (0.0199)	-0.15*** (0.0359)	-1.39*** (0.0559)	1.68*** (0.12)	0.862*** (0.0759)	0.431*** (0.0685)	0.0226 (0.0632)	0.719*** (0.124)	0.341*** (0.0697)	
Togo 2010	-0.214*** (0.028)	-0.132* (0.0531)	-1.59*** (0.11)	1.09*** (0.126)	0.583*** (0.0924)	0.241* (0.11)	0.17 (0.115)	0.475* (0.22)	0.00634 (0.134)	
Trinidad and Tobago 2011	1.45*** (0.156)	0.417 (0.494)	-1.26. (0.71)	15.2 (511)	1.76* (0.741)	1.67* (0.679)	1.73** (0.546)	15.3 (1,031)	1.48** (0.548)	
Uganda 2014	-0.309*** (0.0128)	-0.241*** (0.0273)	-1.16*** (0.058)	1.58*** (0.0628)	0.443*** (0.0479)	0.33*** (0.0476)	0.0375 (0.0482)	0.953*** (0.0837)	0.15** (0.0494)	
Uruguay 2011	0.988*** (0.17)	0.901 (0.585)	-2.01* (0.792)	13.9 (470)	0.653 (0.752)	0.619 (0.716)	1.05. (0.554)	-0.795 (0.751)	0.915 (0.592)	
Venezuela 2001	0.437*** (0.0418)	0.094 (0.0927)	-1.76*** (0.154)	1.21*** (0.201)	1.6*** (0.16)	1.58*** (0.145)	0.626*** (0.13)	0.36 (0.263)	1.85*** (0.148)	
Vietnam 2009	-0.593*** (0.0227)	-1.12*** (0.0406)	-1.91*** (0.056)		2.19*** (0.0829)	1.99*** (0.0706)	1.11*** (0.0664)		1.71*** (0.0695)	
Zambia 2010	0.138*** (0.0251)	0.305*** (0.041)	-1.68*** (0.0859)	1.5*** (0.141)	0.608*** (0.0919)	0.0662 (0.0905)	-0.347*** (0.104)	1.1*** (0.172)	-0.237* (0.102)	-0.342 (0.248)
Zimbabwe 2012	-0.16*** (0.0189)	-0.027 (0.0404)	-1.33*** (0.062)	0.868*** (0.0892)	0.246*** (0.0674)	0.276*** (0.0661)	-0.0203 (0.0686)	0.344** (0.117)	-0.00746 (0.0642)	

Note: in model 2 reference category for household type is “one person household”. Kyrgiz Republic is not included due to low number of observations for household without access to electricity