**Online Appendix**

**National culture and preferences towards on renewable energy in Developing countries**

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**A.1 List of Studies included in the meta-analysis**

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**A.2-Table 1**

**Variable definitions and their summary statistics**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable names** | **Variable Description** |  | |  | |
| **Mean** | **S.D.** | **Studies** | **Obs.** |
| **Dependent variables** | |  |  |  |  |  |
| Ln WTP (Y) | | Natural log of household WTP per month in 2017 US dollar | 3.502 | 0.768 | 98 | 883 |
| **Independent variables** | |  | | | | |
| **National cultures** | |  | | | | |
| Uncertainty avoidance | | A society's tolerance for uncertainty and ambiguity | 54.69 | 16.82 | 98 | 883 |
| Individualism | | The extent people in a society are integrated into groups. | 24.79 | 10.53 | 98 | 883 |
| Masculinity | | The degree to which people prefer achievement, heroism, assertiveness, and material rewards for success. | 49.91 | 10.02 | 98 | 883 |
| Power distance | | The degree to which the less powerful members of organizations and institutions accept and expect that power is distributed unequally | 71.80 | 11.58 | 98 | 883 |
| Long term orientation | | The connection of the past with the current and future actions/challenge. | 44.33 | 21.71 | 98 | 883 |
| **Types of renewable energy** | |  |  |  | 98 | 883 |
| No specific RE | | BD = 1 if energy is not specific types of renewable energy: Baseline category | 0..419 | 0.493 | 54 | 370 |
| Solar energy | | BD = 1 if solar energy | 0.353 | 0.478 | 37 | 312 |
| Hydro energy | | BD = 1 if hydro energy | 0.137 | 0.344 | 9 | 121 |
| Biomass | | BD = 1 if biomass, and biofuels | 0.069 | 0.293 | 11 | 61 |
| Wind energy | | BD = 1 if wind energy | 0.057 | 0.233 | 8 | 51 |
| Geothermal energy | | BD = 1 if geothermal energy | 0.009 | 0.094 | 2 | 8 |
| **Research-design characteristics** | |  |  |  |  |  |
| Survey year | | Year of survey, base 2017 | 7.792 | 3.993 | 98 | 883 |
| Citations | | The logarithm of the number of Google Scholar citations of the study | 1.637 | 1.694 | 61 | 547 |
| Journal rank | | The Scimago journal rank based on the impact factor extracted from Scopus | 0.041 | 0.06 | 51 | 430 |
| Publication | | BD = 1 if individual study was published in a journal | 0.698 | 0.459 | 68 | 617 |
| Metropolitan | | BD = 1 if survey was carried out in metropolitan area | 0.527 | 0.499 | 43 | 466 |
| Pilot survey | | BD = 1 if the survey was piloted | 0.329 | 0.470 | 19 | 108 |
| Validity assessment | | BD = 1 if study conducts validity assessment of designs and estimates | 0.096 | 0.295 | 12 | 85 |
| CVM | | BD =1 if WTP study applies Contingent valuation method | 0.586 | 0.492 | 71 | 518 |
| Interview | | BD = 1 if face-to-face interview was carried out | 0.892 | 0.310 | 85 | 788 |
| Mean WTP | | BD = 1 if the study reports mean WTP | 0.566 | 0.495 | 73 | 500 |
| **Country-specific characteristics** |  |  |  |  |  |
| Household income | The logarithm of household income | 7.068 | 1.046 | 98 | 883 |
| CO2-\_EMIS | The volume of CO2 emissions (metric tons) per GDP | 2.750 | 2.502 | 98 | 883 |
| Climatic disasters | Number of climatic disaster events in year of survey | 9.911 | 9.280 | 98 | 883 |
| Latitudinal position | Latitudinal position in absolute value | 19.873 | 12.913 | 98 | 883 |
| RE Consumption | % of renewable energy in total consumption | 0.357 | 0.251 | 98 | 883 |
| ***Locations*** |  |  |  |  |  |
| Asia | BD=1: if individual study was carried out Asia: Baseline | 0.608 | 0.488 | 49 | 537 |
| Sub-Sahara | BD=1: if individual study was carried in Sub-Sahara Africa countries | 0.207 | 0.405 | 24 | 183 |
| Latin | BD=1: if individual study was carried out in Latin America | 0.091 | 0.288 | 8 | 81 |
| Mena- Europe | BD=1: if individual study was carried out in Mena or Europe | 0.092 | 0.290 | 17 | 82 |
|  |  |  |  |  |  |

**A.3: Methods**

1. **Methods**

***1.1.1 Data collection***

We followed the MAER-Net guidelines 44, 45 in formulating our search criteria, coding strategies and conducting the meta-analysis process. As presented in Figure 1, the first step was to collect all relevant empirical studies, by using four search engines (Science Direct, SCOPUS, Econlit and Google Scholar). The database search was conducted between May 2021 and January 2023 and encompassed a search for the following keywords: ‘willingness to pay’, contingent valuation’, ‘choice experiment’, ‘preferences’ and ‘stated preferences’ in combination with the following terms: ‘green electricity’, ‘solar energy’, ‘wind energy’, ‘geothermal energy’, ‘renewable energy’, ‘hydropower’ and ‘biomass’. Additionally, data were drawn from prior meta-analysis studies by Chaikumbung 12. During the initial phase of the search process, a total of 8,623 studies were identified. Subsequently, by eliminating duplicates, we whittled the count down to 1,425 studies that underwent screening during the first selection phase.

The second step was to select individual studies to include in the dataset. The selection criteria were developed and required that the studies should focus on WTP for renewable electricity sources, estimate WTP using CVM or CE and report WTP in terms of money values. Only WTP studies carried out in developing countries were included. Both published studies (journal articles etc.) and unpublished studies (working papers, conference proceeding papers, project reports, etc.) were included. After screening, 98 studies with 1,098 estimates were included in the initial dataset.

The last step was to code the estimates of WTP together with the explanatory variables. As most studies reported multiple estimates, these WTP estimates were extracted for the purposes of comparison in this meta-analysis. During this coding phase, 215 estimates were excluded due to reporting statistically insignificant results for WTP values. Consequently, our final database comprised 883 estimates sourced from 98 studies. A detailed list of the studies incorporated in our dataset is listed in online Appendix 1.

|  |  |
| --- | --- |
| Additional records identified through other sources:  (n = 71)  The dataset of Chaikumbung (2021): n = 71  Records identified through database searching:  (n = 8,552)  1. Science Direct: n = 1,271  2. SCOPUS: n= 1, 968  3. Econlit: n = 1,677  4. Google Scholar: n=3,636  215 estimates removed   * 215 estimates removed due to reporting insignificant statistical results of WTP values.  |  | | --- | | Records identified through searching and database of Chaikumbung (2021): n = 8,623 **Identification** Duplicates removed (n =7,198 studies)  Records excluded (n = 1,297 studies)   * 1,238 studies did not conduct in Developing countries. * 23 studies were not estimated by CVM or CE * 15 studies did not report WTP in terms of monetary values. * 12 studies did not report the year of value or the year of survey. * 9 studies did not report sample size .   Records screened (n =1,425 studies ) **Screening** Full-text articles assessed  for eligibility (n = 128 studies) **Eligibility** Full-text article excluded (n = 30 studies)   * 30 studies had the same results presented twice in different publications (journal articles and working papers etc.)   Studies included in meta-analysis (n = 98 studies with 1,098 estimates) **Included** |   Final MRA-dataset (n = 98 studies with 883 estimates) |
| **Fig. 1**. Flowchart of study selection process |
|  |

***1.1.2 External information***

To identify the key factors determining public preferences and WTP for renewable energy in developing countries, some data needs to be collected from external sources. First, national cultures were quantified by the index of Geert Hofstede[[1]](#footnote-1). We investigate five cultural dimensions: Uncertainty avoidance, Individualism, Masculinity, Power distance and Long-term orientation. These indexes rank ranges from 0 to + 100 (see table 1). Second, information on CO2 emissions per capita and share of renewables in electricity consumption was retrieved from the World Bank databases[[2]](#footnote-2). Third, information on the number of climatic disasters per year was retrieved from the International Disaster Database[[3]](#footnote-3).

* 1. ***Variables***

All variables used to explain public preference and WTP for renewable energy are drawn from theory and previous studies. Variable definitions and summary statistics are presented in table online Appendices 3.

* + 1. ***Dependent variables***

The dependent variable, referred to as the ‘effect size’ in meta-analyses, standardises findings across studies, enabling simple and direct comparisons. In this meta-analysis study, the effect size is the WTP for renewable electricity. The WTP value estimates were reported in different metrics (WTP per person per kilowatt, WTP per household per month, WTP per person per month etc.), currencies and years of values. To ensure comparability, we converted all WTP values into WTP per household per month based on the purchasing power indices expressed in US$ 2017.

***1.2.2 Explanatory variables***

To identify the key determinants of public preference and WTP for renewable electricity sources, the explanatory variables encompass different categories: national culture, types of green energy sources, country-specific conditions, and research-design characteristics.

***Cultural Variables***

To investigate the influence of cultures on public preferences and WTP for renewables in developing countries, we include the five cultural dimensions (i.e., uncertainty avoidance, individualism, masculinity, power distance and long-term orientation) to our analysis. In our dataset, the average score of uncertainty avoidance, individualism, masculinity, power distance and long-term orientation are 54.69, 24.79, 49.91, 71.80 and 44.33, respectively.

***Types of renewable energy***

Respondents in developing countries may prefer different types of renewable electricity sources. In this meta-dataset, there are six types of renewables (solar energy, hydropower, biomass energy, geothermal energy, wind energy and no specific renewable energy sources). However, we classified renewables into five types: (1) Solar energy, (2) Hydro energy, (3) Biomass energy, (4) Generic renewable energy (no specific renewable energy sources) and (5) Wind and Geothermal energy**[[4]](#footnote-4)**. Of these, the largest number of observations is generic renewable energy, recording 370 observations. Thus, generic renewable energy is selected to be the baseline category of renewable energy types for this analysis.

***Research-design characteristics***

Research design may potentially explain the difference in WTP values. Various research design variables are included in this analysis: the characteristics of research articles (publication status, the number of Google Scholar citations of the study, Journal rank etc.), survey design (e.g., pilot survey, survey conducted in rural or urban areas), survey administration (face-to-face interviews, online surveys, mail correspondence, and telephone survey etc.). Additionally, the year of the survey is included in this model estimation to capture unobserved advancements in methodology, study design and changes in public attitudes over time.

***Country-specific*** ***conditions***

The differences in country socioeconomic features may have different preferences towards renewable electricity sources. We include several country-specific variables in this meta-dataset: The average of household income, the number of climatic disasters per year, latitudinal positions, the share of renewables in total consumption,CO2 emissions per GDP, and geographic locations. We group countries into four geographic locations: (1) Asia, (2) Sub-Sahara Africa, (3) Latin America and (4) MENA- Europe**[[5]](#footnote-5)**. The largest number of observations were from Asia, so Asia is the baseline category.

**Table 1**

**Variable definitions and their summary statistics**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable names** | **Variable Description** |  | |  | |
| **Mean** | **S.D.** | **Studies** | **Obs.** |
| **Dependent variables** | |  |  |  |  |  |
| Ln WTP (Y) | | Natural log of household WTP per month in 2017 US dollar | 3.502 | 0.768 | 98 | 883 |
| **Independent variables** | |  | | | | |
| **National cultures** | |  | | | | |
| Uncertainty avoidance | | A society's tolerance for uncertainty and ambiguity | 54.69 | 16.82 | 98 | 883 |
| Individualism | | The extent people in a society are integrated into groups. | 24.79 | 10.53 | 98 | 883 |
| Masculinity | | The degree to which people prefer achievement, heroism, assertiveness, and material rewards for success. | 49.91 | 10.02 | 98 | 883 |
| Power distance | | The degree to which the less powerful members of organizations and institutions accept and expect that power is distributed unequally | 71.80 | 11.58 | 98 | 883 |
| Long term orientation | | The connection of the past with the current and future actions/challenge. | 44.33 | 21.71 | 98 | 883 |
| **Types of renewable energy** | |  |  |  | 98 | 883 |
| No specific RE | | BD = 1 if energy is not specific types of renewable energy: Baseline category | 0..419 | 0.493 | 54 | 370 |
| Solar energy | | BD = 1 if solar energy | 0.353 | 0.478 | 37 | 312 |
| Hydro energy | | BD = 1 if hydro energy | 0.137 | 0.344 | 9 | 121 |
| Biomass | | BD = 1 if biomass, and biofuels | 0.069 | 0.293 | 11 | 61 |
| Wind energy | | BD = 1 if wind energy | 0.057 | 0.233 | 8 | 51 |
| Geothermal energy | | BD = 1 if geothermal energy | 0.009 | 0.094 | 2 | 8 |
| **Research-design characteristics** | |  |  |  |  |  |
| Survey year | | Year of survey, base 2017 | 7.792 | 3.993 | 98 | 883 |
| Citations | | The logarithm of the number of Google Scholar citations of the study | 1.637 | 1.694 | 61 | 547 |
| Journal rank | | The Scimago journal rank based on the impact factor extracted from Scopus | 0.041 | 0.06 | 51 | 430 |
| Publication | | BD = 1 if individual study was published in a journal | 0.698 | 0.459 | 68 | 617 |
| Metropolitan | | BD = 1 if survey was carried out in metropolitan area | 0.527 | 0.499 | 43 | 466 |
| Pilot survey | | BD = 1 if the survey was piloted | 0.329 | 0.470 | 19 | 108 |
| Validity assessment | | BD = 1 if study conducts validity assessment of designs and estimates | 0.096 | 0.295 | 12 | 85 |
| CVM | | BD =1 if WTP study applies Contingent valuation method | 0.586 | 0.492 | 71 | 518 |
| Interview | | BD = 1 if face-to-face interview was carried out | 0.892 | 0.310 | 85 | 788 |
| Mean WTP | | BD = 1 if the study reports mean WTP | 0.566 | 0.495 | 73 | 500 |
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| **Table 1: cont’** |  |  |  |  |  |
| **Variable names** | **Variable Description** |  |  |  |  |
|  |  | **Mean** | **S.D.** | **Studies** | **Obs.** |
| **Country-specific characteristics** |  |  |  |  |  |
| Household income | The logarithm of household income | 7.068 | 1.046 | 98 | 883 |
| Climatic disasters | Number of climatic disaster events in year of survey | 9.911 | 9.280 | 98 | 883 |
| Latitudinal position | Latitudinal position in absolute value | 19.873 | 12.913 | 98 | 883 |
| Renewable consumption | % of renewable energy in total consumption | 0.357 | 0.251 | 98 | 883 |
| ***Locations*** |  |  |  |  |  |
| Asia | BD=1: if individual study was carried out Asia: Baseline | 0.608 | 0.488 | 49 | 537 |
| Sub-Sahara | BD=1: if individual study was carried in Sub-Sahara Africa countries | 0.207 | 0.405 | 24 | 183 |
| Latin | BD=1: if individual study was carried out in Latin America | 0.091 | 0.288 | 8 | 81 |
| Mena- Europe | BD=1: if individual study was carried out in Mena or Europe | 0.092 | 0.290 | 17 | 82 |
|  |  |  |  |  |  |

* 1. ***Meta-analysis models***

To explain the heterogeneity in reported WTP estimates and identify the important factors explaining the variation in public preference and WTP for green electricity across developing countries, this paper uses the estimated meta‐analysis model. The model is specified as follows:

(1)

where the dependent variable ln (Yij) is the natural logarithm of monthly household WTP expressed in 2017 USD. The subscripts i and j denote an index for 883 estimates reported in 98 studies. *α* is the constant term. The dependent variables are categorised into four different matrices, including the national cultures in ***X***C (i.e., uncertainty avoidance, individualism, masculinity, power distance, and long-term orientation), types of renewables in ***X***RE (e.g., solar energy, hydro energy, and wind energy), research-design characteristics in ***X****m* (e.g., the characteristics of research articles, survey design, and survey administration) and country-specific conditions in ***X****s,* (i.e., household income, climatic disasters, the share of renewables in total consumption, CO2 emissions per GDP, and geographic locations).The vectors ***β****c*, ***β****RE*,***β****m*, and***β****s* are the coefficients of the explanatory variables, and ***ε****ij*is the error term.

Heteroskedasticity is a common issue when estimating the meta-analysis model46 in the equation (1). Practically, this model frequently estimates it by WLS, utilising the inverse variances or standard errors as weights 47-49. A second issue is that, as many studies in our dataset report more than one estimate of WTP, estimates provided in one study may be correlated 46 50. One way of addressing this issue is to use ME, which assumes unobserved between-study heterogeneity 46. Thus, we opted to run OLS, WLS, and ME and cluster standard errors at level of the study.

1. <https://geerthofstede.com/research-and-vsm/dimension-data-matrix/>. Accessed May 30th, 2023. [↑](#footnote-ref-1)
2. <https://info.worldbank.org/governance/wgi/>. Accessed May 30th, 2023. [↑](#footnote-ref-2)
3. <https://www.emdat.be/database>. Accessed May 30th, 2023. [↑](#footnote-ref-3)
4. Due to a small number of observations, wind and geothermal energy are combined into a single wind-geothermal energy. [↑](#footnote-ref-4)
5. Due to a small number of observations, Mena and Europe are combined into a single Mena- Europe. [↑](#footnote-ref-5)