Macroeconomic factors influencing urban-rural divide (বৈষম্য) in electrification rates in South Asia

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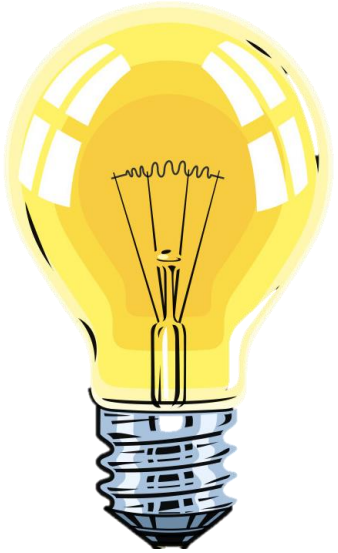
Outline of the presentation

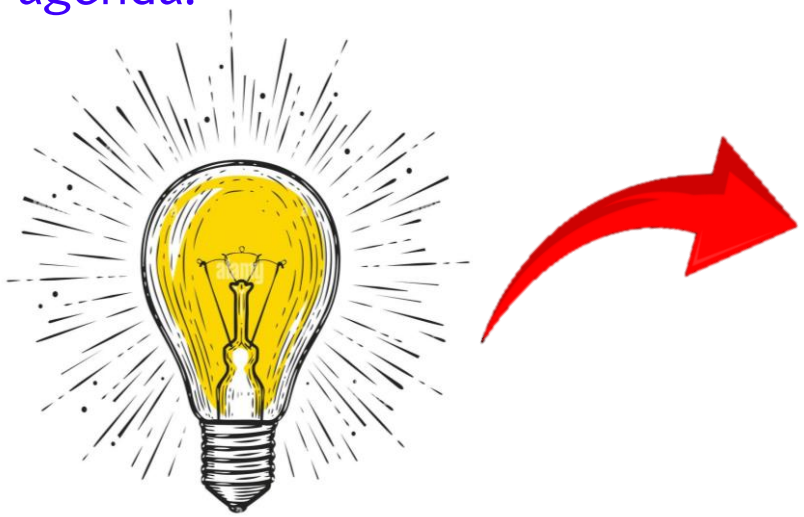


Introduction

Having no access of electricity: Is it a problem?

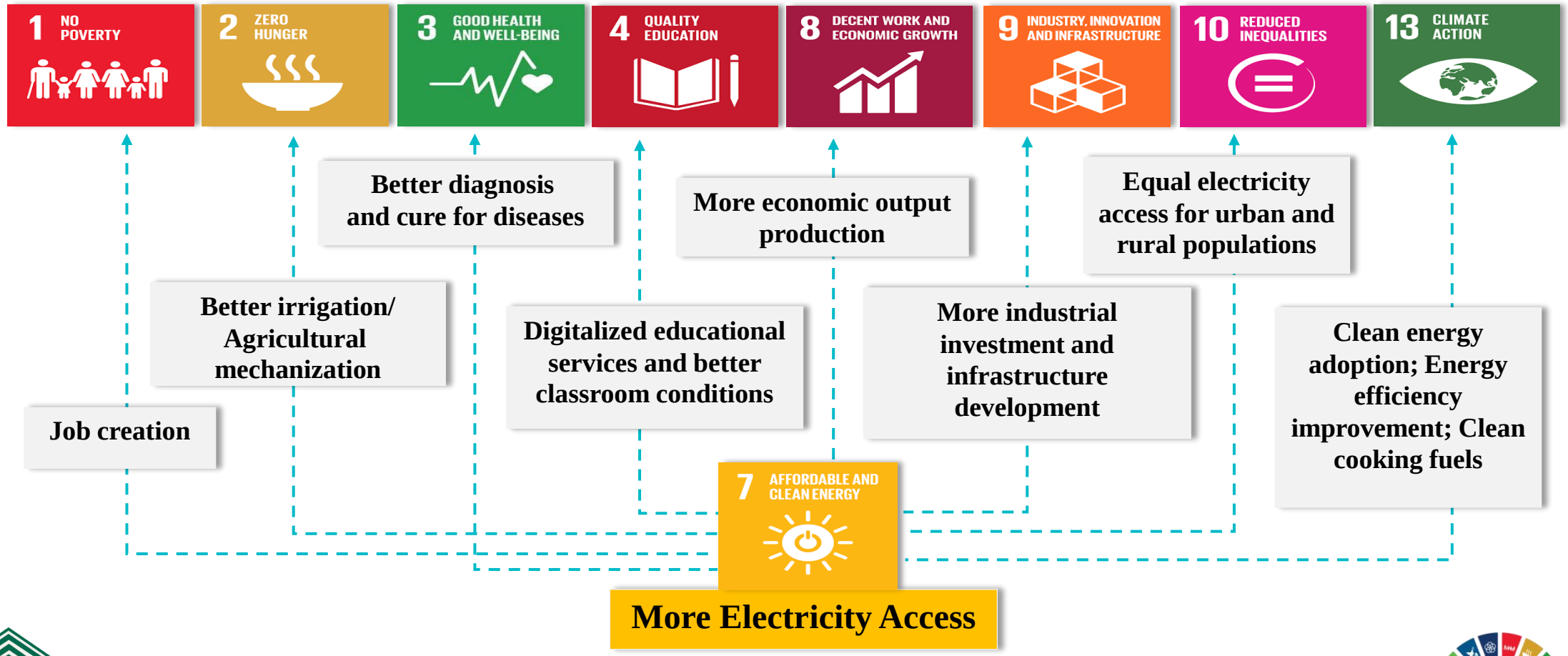
Insufficient access to electricity (or low electrification rate) is indeed a problem that imposes several economic, social, and environmental consequences (Martín-Gamboa et al. 2021; Asghar et al. 2022)

- Accordingly, ensuring universal electricity access (or achieving maximum electrification rate) has been duly emphasized under the United Nations 2030 Sustainable Development Goals (SDG) agenda.



Introduction (contd.)

The interlinkages between electricity accessibility and SDGs



Introduction (Problem Statement)

The discussed linkages between access to electricity and the SDGs stamp the role of improving national electricity accessibility rates globally

- However, speaking of relative deprivation, it is more important to enhance rural electricity accessibility rates **at a relatively faster pace** compared with the rate at which urban electricity accessibility is enhanced
- This calls for policy formulations that can ***eliminate the traditional urban-rural divide in electrification rates*** ; It echoes with the SDG motos of "***leaving no one behind***" and "***ensuring Sustainable Energy for all***"

Objective of the study

This study aims to appraise the macroeconomic factors that influence the urban-rural divide in electrification rates in the context of selected South Asian countries

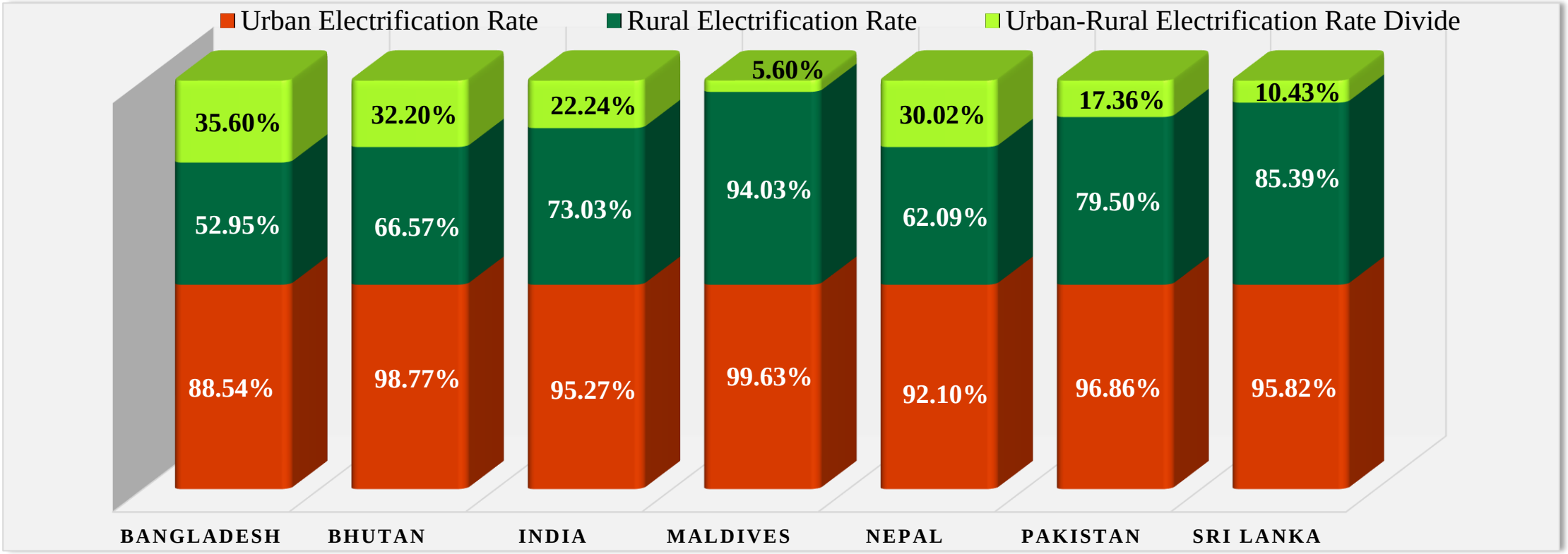
- Bangladesh, India, Pakistan, Sri Lanka, Nepal, Bhutan, and Maldives (*excluding Afghanistan*)

Some stylized facts on South Asia's electrification status:

- In 2022, almost 33 million people in this region had no access to electricity among which around 24.4 million **(74.16%)** were rural residents (World Bank, 2024)
- Besides, throughout most parts of the last couple of decades, urban electrification rates have remained greater than rural electrification rates (*notably, the urban-rural electrification rate divide remained uneliminated in majority of the major South Asian countries including Bangladesh, India, Pakistan, and Nepal*) (World Bank, 2024)

Objective of the study (contd.)

An overview of the urban-rural electrification rate divide scenario across South Asia (Period 2000-2022)



Source: *Author's estimates using data from World Bank (2024)*

Contributions of the study

In terms of novelty, this study makes a couple of contributions to the extant literature:

- Though several preceding studies have assessed how national, urban, and rural electrification rates are determined in South Asia and beyond (Oda and Tsujita 2011; Ogunro and Afolabi 2022), none focused on the pertinence of eliminating South Asia's urban-rural divide in electrification rates (*neither using panel nor using single-country data*)
  - ✓ Apart from assessing the factors influencing urban-rural electrification divide, the impacts of these factors on corresponding urban and rural electrification rates are also separately evaluated (*for better understanding of the spatial heterogeneity of influencing mechanisms*)

- Most existing studies used **household data** to understand the micro-determinants of rural and urban electricity accessibility (Musango 2014; Ogunro and Afolabi 2022). However, similar studies from macroeconomic viewpoints points are yet to be conducted in the South Asian context

Review of Literature

Overall, the focus of researchers in the past was mostly on understanding how national electrification rates are determined. Later, emphasis was given to understanding the within-county geographical spread of electrification rate determinants, particularly across urban and rural areas

- Financial development-led rise in *credit provisions* to private sectors, helps to electrify Sub-Saharan African nations (Byaro and Mmbaga 2022)
- *Low financial investment impedes* national electrification rate improvement in West African countries (Owolabi *et al.* 2021)
- Ensuring *good governance* and attracting *foreign direct investment* are essential for improving national electrification rates across Africa (Aluko *et al.* 2023)
- Since food production requires electricity, mainly for irrigational purposes, *expansion of the agricultural sector* is also likely to raise electrification rates (Byaro and Mmbaga 2022)
- Rwanda's national electrification rate is positively influenced by *gross capital formation* (Mwizerwa and Bikorimana 2018)
- Emphasizing on *affordability, inflationary pressures* are linked with lower electrification rates in Sub-Saharan African countries (Sievert and Steinbuks 2020)
- *Globalization* is essential for improving rural electrification rates in Africa (Noumba and Nguea 2023)

Review of Literature (contd.)

- *Economic growth* helps to enhance urban electrification rates in China (Milin *et al.* 2022).
- Establishing *good governance* promotes electrification rates in Southeast Asian states (Taghizadeh-Hesary *et al.* 2022)

- In **South Asian** context, **using household data**, Abbas *et al.* (2020) asserted that more *educational attainment* and *greater household wealth* reduce deprivation in terms of electricity accessibility
- In India (**using household-level data**), Poblete-Cazenave and Pachauri (2021) claimed that achieving maximum electrification rate is conditional on effective controlling of *electricity prices*
- Rural electrification rate improvement in South Asia is determined by the *quality of its institutions* (Boräng et al. 2021)
- A *strong electricity regulatory body* can enhance rural electrification rates in South Asia (Palit and Chaurey 2011)

Empirical Model and Data

Model 1: Urban-Rural divide in Electrification rate = *f (access to formal credit, remittance receipts, institutional quality, financial globalization, inflation, urban-rural population growth differential)*

- **Urban-Rural divide in Electrification rate:** It is estimated as the difference between urban and rural electrification rates *(the higher the value the greater the disparity in electricity accessibility across urban and rural regions)*
- **Access to formal credit:** It is proxied by domestic credit provided to private sector by banks *(notably, more access to such credit can be assumed to make electricity more available and affordable)*
- **Remittance receipts:** It is proxied by net foreign remittances received by left-back household members of migrants *(notably, remittances augment household expenditure budgets which can be spent for electricity consumption purposes)*
- **Institutional Quality:** It is specifically proxied by the extent of corruption control *(notably, under the existence of corruption-free institutions (or good quality institutions), a more equitable availability of electricity can be ensured across urban and rural areas, irrespective of the class of the electricity consumer)*
- **Financial Globalization:** It is proxied by net Foreign Direct Investment (FDI) receipts *(notably, FDI are sources of external finance for energy infrastructure development, energy innovation, renewable energy development)*

Empirical Model and Data (contd.)

Model 1: Urban-Rural divide in Electrification rate = *ƒ (access to formal credit, remittance receipts, institutional quality, financial globalization, inflation, urban-rural population growth differential)*

- **Inflation:** It is proxied by the Consumer Price Index *(notably, inflationary pressures are likely to raise electricity prices, as well; consequently, consumers' capacities to purchase electricity are expected to be adversely impacted, especially in rural areas comprising poor households)*
- **Urban-Rural population growth differential:** It is given by the difference between urban and rural population growth figures *(notably, a relatively higher urban population growth rate would be linked with hikes in urban energy demand and since electricity is relatively more available in urban areas, the rise in the urban-rural population growth rate differential can be expected to reduce rural availability of electricity further)*

Model 2: Urban Electrification rate = *ƒ (access to formal credit, remittance receipts, institutional quality, financial globalization, inflation, urban-rural population growth differential)*

Model 3: Rural Electrification rate = *ƒ (access to formal credit, remittance receipts, institutional quality, financial globalization, inflation, urban-rural population growth differential)*

Empirical Model and Data (contd.)

Data: Annual data from **2000 to 2022** is utilized (*****based on availability*)

Variable	Unit	Source
Urban-rural divide in electrification rates (***Difference between urban and rural electricity access rates***)	%	Author's calculation using data from World Bank (2024)
Access to formal credit (***domestic credit provided by banks***)	% of GDP	World Bank (2024)
Foreign remittance receipts	% of GDP	World Bank (2024)
Control of Corruption (*proxy for institutional quality*)	Index	World Bank (2024)
Net receipts of FDI (*proxy for financial globalization*)	% of GDP	World Bank (2024)
Urban-rural population growth rate differential (***Difference between urban and rural population growth rates***)	%	Author's calculation using data from World Bank (2024)
Inflation (***consumer price index, Year 2010=100***)	Index	World Bank (2024)
Urban electrification rate (***proportion of urban population having electricity access***)	%	World Bank (2024)
Rural electrification rate (***proportion of rural population having electricity access***)	%	World Bank (2024)

Estimation Methods

The estimation procedure comprises five stages:

- **Stage 1:** Cross-sectional dependency analysis → Pesaran (2015, 2021); Juodis and Reese (2021); Fan et al. (2015); Pesaran and Xie (2021)
- **Stage 2:** Slope Heterogeneity analysis → Pesaran and Yamagata (2008); Blomquist and Westerlund (2013); Bersvendsen and Ditzen (2021)
- **Stage 3:** Panel unit root analysis → Herwartz and Siedenburg (2008); Demetrescu and Hanck (2012); Herwartz et al. (2018)
- **Stage 4:** Panel cointegration analysis → Westerlund (2007)
- **Stage 5: Regression analysis** → **Anderson-Hsiao two-step Generalized Method of Moments**

Estimation Methods (contd.)

Regression Technique: Anderson-Hsiao two-step Generalized Method of Moments

Why was it chosen?

- Firstly, like all other Generalized Method of Moments (GMM)-based regression methods, the Anderson-Hsiao two-step Generalized Method of Moments (AH-2S-GMM) estimator has *good finite sample properties*
- Secondly, the AH-2S-GMM estimator is ***robust against the limitations*** of the conventional GMM techniques which include:
  - The GMM estimator of Anderson and Hsiao (1981) performs *poorly with small panel data sets*
  - The first difference GMM estimator of Arellano and Bond (1991) and the system GMM estimator of Blundell and Bond (1998) *generate inefficient outcomes due a bias that is exerted by imposing too many restrictive conditions*
  - Specifically, regarding the issue of *endogeneity*, the traditional GMM estimators adopt instrumental variable approaches that suffer from the issue of *inappropriate instrumentation*

Estimation Methods (contd.)

Regression Technique: Anderson-Hsiao two-step Generalized Method of Moments

Robust features of the AH-2S-GMM estimator:

- Firstly, the AH-2S-GMM regression method *imposes bias-corrected quadratic moment conditions* whereby it is deemed *effective in generating efficient coefficients* that are affected by the restrictive conditions imposed by the traditional GMM techniques
- Secondly, the AH-2S-GMM method *adopts a self-instrumentation approach* to deal with endogeneity issues; thus, relieving the burden of looking for appropriate instrumental variables that are to be arbitrarily included in the estimation process
- Thirdly, unlike the GMM estimator of Arellano and Bond (1991) which uses lagged levels of covariates as instrumental variables, the AH-2S-GMM estimator *uses first difference levels of covariates for instrumentation purposes* whereby the estimates derived using the AH-2S-GMM estimator are said to be more efficient (Alhassan *et al.* 2024)

Results and discussions

Preliminary Results:

- The issue of *cross-sectional dependency* is confirmed
- *Slope heterogeneity* concerns are detected
- All variables are *integrated (or stationary)* at the 1st difference
- Presence of *cointegrating relationships* is affirmed

Results and discussions (contd.)

Results from AH-2S-GMM regression analysis for Model 1:

- More access to formal credit **reduces** the urban-rural divide in electrification rates
  - *If private sector-based domestic credit's of the GDP increases by 1%, the difference between urban and rural electrification rates is expected to drop by around 0.4 percentage points, ceteris paribus*
- Foreign remittance receipts **widen** the urban-rural divide in electrification rates
  - *If foreign remittance receipts' share of the GDP rises by 1%, it could enlarge the gap between urban and rural electrifications rates by around 2.5 percentage points, ceteris paribus*
- Improving institutional quality by effectively controlling corruption **reduces** the urban-rural divide in electrification rates
  - *If the value of the corruption control index increases by 1%, the urban-rural electrification rate divide may be expected to decline by 4.6%, ceteris paribus*
- Globalizing financially by attracting more FDI **reduces** the urban-rural divide in electrification rates
  - *If incoming FDI account for an additional 1% of the GDP of the respective South Asian nations, the difference between their urban and rural electrification rates is likely to be reduced by around 0.5 percentage points, ceteris paribus*

Results and discussions (contd.)

Results from AH-2S-GMM regression analysis for Model 1 (contd.):

- Higher urban-rural population growth **widens** the urban-rural divide in electrification rates
  - *If urban population grows at a rate that is 1% higher than the growth rate of rural population, the urban-rural electrification rate divides in the selected South Asian countries are likely to widen by around 5.4 percentage points, ceteris paribus*
- Inflationary pressures **reduce** the urban-rural divide in electrification rates
  - *If inflation rates go up by 1%, the urban-rural electrification rate divides are likely to decline by around 0.3 percentage points, ceteris paribus*
- Lastly, among the other interesting findings, the results show that the selected South Asian countries are somewhat in the right track to reducing their urban-rural electrification rate divides year-on-year
  - *The predicted negative sign of the coefficient corresponding to the one-year lagged dependent variable (urban-rural divide in electrification rates) indicates that compared to the previous year, the divide is likely to be lower in the subsequent year*

Results and discussions (contd.)

Table 1: Results from AH-2S-GMM regression analysis for Model 1
(Dependent Variable : *Urban-Rural divide in Electrification rate*)

Regressors	Coefficient	Std. Error	Z statistic	Probability
Access to formal credit	-0.381***	0.066	-5.79	0.000
Remittance receipts	2.470***	0.653	3.78	0.000
Institutional quality (control of corruption)	-4.600***	1.330	-3.73	0.000
Financial globalization (FDI inflows)	-0.477***	0.048	-9.88	0.000
Urban-rural population growth differential	5.403***	0.518	10.42	0.000
Inflation	-0.331***	0.040	-8.35	0.000
L1(Urban-rural divide in electrification rate)	-0.419***	0.038	-11.12	0.000
Observations	154			
Diagnostic tests	***Null Hypothesis***		***Test statistic***	***Probability***
Arellano-Bond	*No autocorrelation of order 1*		*1.101*	*0.271*
	No autocorrelation of order 2		*-1.144*	*0.253*
Portmanteau	*No autocorrelation*		*6.815*	*0.448*
Sargan-Hansen	*Valid overidentifying restrictions*		*6.218*	*1.000*

*Note: *** certifies significance at 1% significance level*

Results and discussions (contd.)

Results from AH-2S-GMM regression analysis for Models 2 and 3:

- More access to formal credit **reduces rural electrification rates** but does not affect urban electrification rates
- Foreign remittance receipts **reduces rural electrification rates** but does not affect urban electrification rates
- Improving institutional quality by effectively controlling corruption **boosts rural electrification rates** but does not affect urban electrification rates
- Globalizing financially by attracting more FDI **boosts rural electrification rates** but does not affect urban electrification rates
- Higher urban-rural population growth **reduces rural electrification rates** but does not affect urban electrification rates
- Inflationary pressures **boost both urban and rural electrification rates**

Results and discussions (contd.)

Table 2: Results from AH-2S-GMM regression analysis for Models 2 and 3

(Dependent Variables : *Urban and Rural Electrification rates, respectively*)

Regressors	Model 2 (Urban electrification rate)		Model 3 (Rural electrification rate)	
	Coefficient	Std. Error	Coefficient	Std. Error
Access to formal credit	0.113	0.116	-0.275***	0.033
Remittance receipts	1.184	1.956	-6.390***	0.401
Institutional quality (control of corruption)	4.546	7.766	12.967***	2.542
Financial globalization (FDI inflows)	0.125	0.811	0.497***	0.938
Urban-rural population growth differential	-1.181	1.748	-2.077**	0.938
Inflation	0.045*	0.025	0.483***	0.033
L1(Urban electrification rate)	0.352	0.492		
L1(Rural electrification rate)			0.518	0.530
Observations	154		154	
Diagnostic tests (null hypothesis)	*Test statistic*	*Probability*	*Test statistic*	*Probability*
Arellano-Bond (no autocorrelation of order 1)	*0.728*	*0.467*	*1.168*	*0.243*
Arellano-Bond (no autocorrelation of order 2)	*0.781*	*0.435*	*0.558*	*0.577*
Portmanteau (no autocorrelation)	*7.000*	*0.429*	*6.953*	*0.434*
Sargan-Hansen (valid overidentifying restrictions)	*0.000*	*1.000*	*5.288*	*1.000*

*Notes: ***, **, & * certify significance at 1%, 5%, & 10% significance level, respectively*

Concluding remarks

- Underscoring the necessity ***of eliminating the urban-rural divide in electrification rates*** for achieving several of the SDGs (including SDG-1, SDG-2, SDG-3, SDG-4, SDG-7, SDG-8, SDG-9, SDG-10, and SDG-13), this study appraised how different macroeconomic variables influence this electrification divide in seven South Asian nations during the 2000-2022 period. In a nutshell, the results affirmed:
  - *More formal credit accessibility, better corruption controlling capacities, FDI attraction, and inflation taming reduce urban-rural electrification divides while more receipts of foreign remittance and larger differences between urban and rural population growth rates were found responsible for widening the urban-rural electrification rate divide further*
  - *Further, the findings showed that while inflation is the only macroeconomic factor responsible for boosting urban electrification rates in South Asia*
  - *Rural electrification rates in the concerned South Asian countries are influenced by all macroeconomic factor considered. Precisely, the results affirmed that rural electrification rates are positively influenced by corruption control, FDI attraction, and rising inflationary pressures but negatively influenced by more formal credit access, foreign remittance receipts, and rising disparity between urban and rural population growth rates*

Therefore, policymakers in South Asia should take note of the above findings when designing action plans for eliminating discrepancies between urban and rural electrification rates

Policy recommendations

- Financial policy reforms are needed, especially in rural areas so that no one in the rural neighborhoods are left deprived of access to electricity
  - *microcredit provision against low collateral and at negligible interest rates can be an option*
  - *rural financial inclusion rates need to be enhanced*
  - *conducive environment for boosting private investment in power sector should be emphasized*
- Amendments are needed in labor migration policies with special focus on labor-skill upgradation (human capital development) for rural migrants, in particular
  - *rural skill development workshops (free of cost) can be introduced*
  - *rural remittance-receiving procedures should be made easier (hassle-free) and relatively more cash incentives should be provided*
  - *Introduction of remittance-specific financial institutions can be set up in rural areas*
- Across-the-board (both in urban and rural areas) corruption controlling-measures should be strengthened (especially in power-sector-related institutions)
  - *regular audits should be conducted in power sector-based institutions*
  - *agents responsible for impeding equitable urban-rural distribution of electricity should be prosecuted and not be allowed to walk-free in exchange of rents/bribes*

Policy recommendations (contd.)

- Financial globalization policies should integrate the issue of universal access to electricity
  - *more energy sector-related FDIs should be attracted*
  - *FDIs related to technological spillovers relevant for off-grid rural electrification should be emphasized*
  - *favorable returns on FDI should be ensured*
  - *intra-regional financial globalization policies should be formulated*

- Across-the-board (both in urban and rural areas) effective inflation controlling policies should be considered
  - *a managed (regulated) market-based electricity pricing framework should be introduced*
  - *shielding consumers against electricity price-volatility is highly essential, especially in the context of rural consumers*

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Thank You

Let's strive to ensure maximum electrification rates and establish a level-playing field for attaining nationally-inclusive socioeconomic and environmental development across South Asia