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THE IMPACT OF ELECTRIFICATION AND GOVERNMENT POLICIES ON URBANIZATION IN SOUTH ASIA

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Effective urbanization serves as a pivotal indicator for advancing socio-economic development. While developed nations have realized this objective successfully, propelled by advancements in the electrical sector, South Asian countries face hindrances, primarily limited access to electricity. This study delves into the impact of government policies on electricity concerning urban development, utilizing panel data spanning from 1996 to 2021. Applying the Pooled Mean Group (PMG) regression method, the research discerns electricity's substantial influence on the urbanization process in South Asian countries. Additionally, it uncovers the positive correlation between government expenditures and urban development, despite the detrimental effects of government employees' efficiency and monetary policies. These detriments are linked to skill shortages, corruption, and inadequate future development planning. To facilitate urbanization progress, South Asian governments must prioritize enhancing electricity access, improving employee efficiency, and adjusting monetary policies. This strategic approach can pave the way for accelerated urban development and comprehensive socio-economic growth.

Keywords: urbanization, electrification, economic development of South Asian nations, monetary policy, government effectiveness

ВЛИЯНИЕ ЭЛЕКТРИФИКАЦИИ И ПРАВИТЕЛЬСТВЕННЫХ ПОЛИТИК НА УРБАНИЗАЦИЮ В ЮЖНОЙ АЗИИ

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Эффективная урбанизация является ключевым показателем социально-экономического развития. В то время как развитые страны успешно достигли этой цели благодаря прогрессу в электроэнергетическом секторе, страны Южной Азии сталкиваются с препятствиями, в первую очередь из-за ограниченного доступа к электроэнергии. Данное исследование анализирует воздействие государственной политики на электроэнергию в контексте городского развития с использованием панельных данных за период с 1996 по 2021 год. Применяя метод регрессии Pooled Mean Group (PMG), исследование выявляет существенное влияние электроэнергии на процесс урбанизации в странах Южной Азии. Кроме того, оно раскрывает положительную корреляцию между государственными расходами и городским развитием, несмотря на негативные эффекты эффективности государственных служащих и денежно-кредитной политики. Эти негативные явления связаны с нехваткой квалифицированных кадров, коррупцией и недостаточным планированием будущего развития. Для стимулирования урбанизационного прогресса правительства Южной Азии должны придерживаться стратегии, направленной на расширение доступа к электроэнергии, повышение эффективности государственных служащих и корректировку денежно-кредитной политики. Этот стратегический подход может способствовать ускоренному развитию городов и общему социально-экономическому росту.

Ключевые слова: урбанизация, электрификация, экономическое развитие стран Южной Азии, денежно-кредитная политика, эффективность правительств

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Introduction

The modern era is characterized by globalization and rapid development, wherein technological advancements have improved the quality of life significantly compared to the past. However, not all individuals have equal access to these facilities, particularly in rural areas where employment opportunities, education quality, and the standard of living are relatively limited compared to urban areas. Therefore, individuals often express an intention to move to urban areas, leading to urbanization. Unfortunately, the global urbanization process has not been uniformly well- managed. While developed countries have planned cities effectively, many developing and poor nations have experienced unplanned urban expansion, resulting in compromised living conditions for their inhabitants. Recognizing the urgent need to address this issue, the United Nations (UN) has included "better urbanization" as the 11th goal among its seventeen sustainable development goals (SDGs), with a targeted achievement by 2030. To realize the SDGs, the UN must focus particularly on developing and poor countries, with South Asian countries emerging as a crucial area for attention. This region is home to a significant portion of the global population and comprises several least developed or developing nations, including Bangladesh, India, Pakistan, Sri Lanka, and Nepal.

The term "Urbanization" refers to the concentration of people in a specific geographic area, transformed for residential, commercial, industrial, and transport purposes. Based on these factors, ancient cities were built, and people migrated to urban areas for economic reasons. Cities in South Asian countries such as Delhi, Mumbai, Karachi, Dhaka, Colombo, and others were also established for similar reasons. Commercial companies and factories have been built beside these cities, making them favorable destinations due to the employment opportunities. Additionally, these cities offer a better quality of life, entertainment options, healthcare, education facilities, prompting people from South Asian villages to migrate. According to a paper by A. Pandey and M. Asif (2022), 36.6 % of people live in urban areas of this region [1]. Here, accessibility of electricity has significantly contributed to the urbanization process, facilitating industrialization, leading to increase employment opportunities, and improving overall living conditions. Furthermore, government expenditure and policies, such as infrastructure development, free education, healthcare facilities, and others also play a role in influencing urbanization.

The discussion above emphasizes the role of electricity, and government policies in urbanization in South Asia. However, well-planned urbanization is lacking in the region. This has motivated me to investigate further how electrification can contribute to the urbanization of South Asian countries, considering factors such as governmental efficiency and annual expenditures.

The role of electricity in Urbanization

Our study aims to explore the role of electrification in promoting urban development in South Asia. For such a purpose, we conducted a comprehensive literature review, encompassing various regions and specifically focusing on the South Asian context, with the aim of observing the connection between electricity access, and urbanization, not only at a regional level but also globally. For example, Nathaniel et al (2020) endeavored to illustrate the relationship between electricity consumption, urbanization, and economic growth in Nigeria [2]. Nathaniel utilized time series data from 1971 to 2014, employing bound testing and co-integration analysis to demonstrate that electricity promotes economic growth and urbanization in both the short and long run. Similar research was undertaken by Ali et al (2020), Sbia et al (2017), and Song et al (2022) for Nigeria, UAE, and China, respectively [3; 4; 5]. Additionally, Daniel et al (2021) delved into the multidimensional nexus among renewable energy, economic growth, population growth, and urbanization globally [6]. This study used panel data from 106 countries spanning 1990–2014, revealing a long-term unidirectional and bidirectional relationship between the variables.

Some researchers focused on the environmental implications of urbanization and electricity consumption, with Ali et al (2017) being one of them [7]. He observed the impact of urbanization on carbon dioxide emissions in Singapore, revealing a negative and significant relationship that indicates urbanization does not hinder environmental quality, as it reduces carbon emissions. However, economic growth has a positive and significant impact on emissions. Similar findings were observed for Ghana and Tunisia by Nayaga et al (2021) and Kwakwa (2020) [8; 9]. Several studies in the South Asian region, include Halder and Sharma's (2022) examination of urbanization, electricity consumption, and emissions in India [10]. The study suggested that urbanization, GDP, and population growth contribute to increased electricity demand and carbon dioxide emissions. Similarly, Voumik et al (2023) investigated the relationship between urbanization, industrialization, and carbon emissions in South Asian countries, proposing that a higher use of electricity and adopting natural resources rent could effectively reduce environmental degradation while improving urbanization, and industrialization [11]. Furthermore, Asgar et al (2022) and Raihan et al (2022) conducted research on a similar context for Pakistan and Bangladesh, respectively [12; 13].

The role of government in urbanization

In addition to electricity, government policies, including public project expenditures, the efficiency of government employees, and monetary policies, also play crucial roles in urbanization. The government allocates funds for the overall development of the country, such as infrastructure development, education, healthcare facilities, and others, with a significant portion directed towards urban areas. Moreover, government policies are created to regulate people's behavior and ensure a better quality of life for their population. Therefore, the effectiveness of government employees becomes important in implementing these policies. Liu and Su (2021) examined the interaction between the development of transport facilities and urbanization in China, highlighting positive effects on urbanization due to government investment in improving transportation facilities [14]. Tripathi (2020) focused on BRICS countries, identifying a missing connection between macroeconomic factors and urban policies [15; 16]. His study emphasized that factors such as FDI, GDP, trade, employment, broad money, and energy use significantly impact urbanization. Furthermore, GDP growth rate and gross capital formation play crucial roles in urban population growth. Integrating these macroeconomic factors is essential for enhancing urban policies for economic development.

While these studies have delved into urbanization, economic development, and the environment, they often overlook proper urban planning and the role of government efficiency in South Asian countries. Additionally, some of these studies use outdated or irrelevant data for the South Asian context. Therefore, we aim to address this research gap by investigating how the combination of electricity, government policies, and monetary policies can contribute to ensuring a better urban life for the people in South Asian countries.

Background data and research methodology

The primary objective of this paper is to investigate the role of electricity in the urbanization process within five selected South Asian countries: Bangladesh, India, Pakistan, Nepal, and Sri Lanka. Furthermore, we aim to examine how government expenditures, government effectiveness, and national monetary policies influence the expansion of urban areas. To achieve this, we utilized panel data on per capita electricity consumption (LEPC), government expenditures (LGEX), government effectiveness (LGEF), the number of urban populations (LURP), and broad money (LBM) for our selected countries during the period from 1996 to 2021. Table 1 provides detailed information about these variables and their sources. All the data for our variables were collected from the World Bank Development Indicators (WDI).

Table 1 – Definition of the Variables

Code	Variable Name	Variable Description	Units	Source
LURP	Urban population	The number of people live in urban area	Numerical unit	World Bank[1]
LEPC	Per capita electricity consumption	Annual per capita electric power consumption	kWh	
LGEX	Government Expenses	Government expenses for purchasing goods and services in a year	Dollar	
LGEF	Government Effectiveness	The World Bank prepared a percentile rating (ranging from 0 to 100) based on the quality of public service, the capability of policy implementation, and the level of political interferences	Numerical unit	
LBM	Broad Money	The money that is circulating in the economy (% of GDP)	Dollar	

Research methodology is a systematic process that explains how information is analyzed and helps in reaching decisions for a specific problem. In our study, our aim is to investigate the role of electricity access, fiscal policies, and monetary policies in the urbanization process in the South Asian region. Therefore, our dependent variable is the urban population, while all other variables are independent. The empirical model for our study will be as follows (1):

$$LURP = f(LEPC, LGEX, LGEF, LBM), \tag{1}$$

here LURP – urban population (the number of urban dwellers);

LEPC – per capita electricity power consumption;

LGEX – annual government expenditures;

LGEF – government effectiveness;

and LBM – Broad money.

We can present our function model in the following form (2).

$$LURP_{it} = \alpha_{it} + \beta LEPC_{it} + \gamma LGEX_{it} + \theta LGEF_{it} + \delta LBM_{it} + \varepsilon_{it}, \tag{2}$$

here i – number of panel countries;

t – data over time for certain panel countries;

α – constant term;

ε – error term;

$\beta, \gamma, \theta, \delta$ – the corresponding coefficients of per person electricity consumption (LEPC), government expenditures (LGEX), government effectiveness (LGEF) and broad money (LBM).

CD and Stationarity Test: Since our study involves panel data, it is essential to conduct a cross-sectional dependency (CD) test to examine the correlations between the data. For this purpose, we will apply the method proposed by Pesaran (2004) [17].

$$CD = \sqrt{\frac{2F}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \frac{(F-d)\hat{\rho}_{ij}^2 - E[(F-d)\hat{\rho}_{ij}^2}{var\left[(F-d)\hat{\rho}_{ij}^2\right]}, \tag{3}$$

here N – number of panel data's cross-sectional dimension;

F – dimension of time;

and $\hat{\rho}_{ij}^2$ – residuals based on pairwise correlation calculated from the sample.

We also need to assess the stationarity characteristics of our data. To accomplish this, we will use two methods suggested by Pesaran el at (2013) known as the CADF and CIPS tests [18]. The formulas for the CADF and CIPS tests are as follows:

$$\text{CADF: } \Delta X_{i,t} = \delta_i + \theta_i X_{i,t-1} + \gamma_i \bar{X}_{t-1} + \sigma_i \Delta \bar{X}_{i,t} + \varphi_{it}, \tag{4}$$

here cross sectional mean $\bar{X}_{t-1} = \frac{1}{N}\sum_{i=1}^{N} X_{i,t-1}; \Delta \bar{X}_{i,t} = \frac{1}{N}\sum_{i=1}^{N} X_{i,t}$.

[1] World Bank. Data Bank: World Development Indicator, 2023. – URL: https://databank.worldbank.org/source/world-development-indicators (date of application: 14.10.2023). – Text: electronic.

$$\text{And CIPS (N, T)}: \frac{1}{N}\sum_{i=1}^{N} t_i\left(N,T\right), \tag{5}$$

here t_i(N, T) – ratio of ordinary least square estimation at θ_i.

Co-integration and regression test: A regression test is conducted to examine the relationship between dependent and independent variables. However, before conducting the regression test, we need to perform a co-integration test on our variables to determine whether such a test is applicable. If the panel data exhibits independent characteristics, then the first-generation co-integration formula will not suitable for that data. In that case, following Westerlund's (2007) formula (6) can be performed [19].

$$\Delta Y_{i,t} = \delta_i' d_t + \alpha_i\left(Y_{i,t-1} - \beta_i' X_{i,t-1}\right) + \sum_{j=1}^{p_i}\alpha_{ij}\Delta Y_{i,t-j} + \sum_{j=q_i}^{p_i}\gamma_{ij}\Delta X_{i,t-j} + \varepsilon_{i,t}, \tag{6}$$

here t =1, 2, …, T denote the time series data;

I = 1, 2, …, N for cross-sectional units;

d_t – deterministic factor;

and α_i – the error correction coefficient of CD test.

Westerlund (2007) also proposed two formulas, which are mentioned in equations (7) and (8), to examine the null hypothesis [19].

$$G_\tau = \frac{1}{N}\sum_{i=1}^{N}\frac{\hat{\partial}_i}{Se\left(\hat{\partial}_i\right)}. \tag{7}$$

$$G_\alpha = \frac{1}{N}\sum_{i=1}^{N}\frac{T\hat{\partial}_i}{1-\sum_{j=1}^{k}\hat{\partial}_{ij}}. \tag{8}$$

Following P_τ and P_α statistics are applied to test the existence of co-integration in panel data (9)–(10).

$$P_\tau = \frac{\hat{\partial}}{Se\left(\hat{\partial}\right)}. \tag{9}$$

$$P_\alpha = T\hat{\partial}. \tag{10}$$

To examine the short and long run relationship this study will use Pesaran's et al (1999) Pooled Mean Group (PMG) estimation formula presented in (11) [20].

$$\Delta\left(y_i\right)_t = \sum_{j=1}^{p-1}\partial_j^i\Delta\left(y_i\right)_{t-j} + \sum_{j=0}^{q-1}\omega_j^i\Delta\left(X_i\right)_{t-j} + \pi^i\left[\left(y_i\right)_{t-1} - \beta_1^i\left(X_i\right)_{t-1}\right] + \beta_0^i + \mu_t + \varepsilon_{it}, \tag{11}$$

here ∂_j^i and ω_j^i – short-run coefficients;

π^i – the error correction adjustment speed;

β_1^i – long-run coefficient;

β_0^i – country wise fixed effect;

and ε_{it} – stochastic error.

Panel Causality Test: In the heterogeneous non-causality test, all independent variables exhibit Granger causality, whereas the dependent variables do not. To address this issue, Dumitrescu and Hurlin (2012) proposed a modification to the Granger's model, as presented below (12) [21].

$$\Delta Y_{i,t} = \alpha_i + \sum_{k=1}^{K}\mu_{ik}Y_{i,t-k} + \sum_{k=1}^{K}\theta_{ik}X_{i,t-k} + \varepsilon_{i,t}, \tag{12}$$

here μ_{ik} – dependent variables' coefficient;

θ_{ik} – independent variables' coefficient;

i – cross-sectional dimension (i = 1, 2, …, N);

t – time period (t=1, 2, …, T);

k – lag term.

Due to the different standard of units, these coefficients may vary in short run test. The null hypothesis can express as

$$H_0\text{: } \theta_{i1} = \dots\dots\dots = \theta_{ik} = 0;\ \forall i = 1,\dots N_1. \tag{13}$$

From the equation (13) the alternative null hypothesis may developed as following (14)–(15):

$$H_I\text{: } \theta_{i1} = \dots\dots\dots = \theta_{ik} = 0,\ \ \forall i = 1,\dots N_1. \tag{14}$$

$$\text{And, } \theta_{i1} \neq 0\ or \dots or\ \theta_{ik} \neq 0, \forall i = N_1 + 1,\dots, N\text{; where } 0 \leq \frac{N_1}{N} \leq 1. \tag{15}$$

It was advised by Dumitrescu and Hurlin (2012) to perform regression test for N cross sections and F-test for K linear hypotheses with $\theta_{i1} = \dots\dots\dots = \theta_{ik} = 0$. We can use following Wald statistic formula to determine the average(16):

$$\bar{L} \leq \frac{1}{N}\sum_{i=1}^{N} L_i, \tag{16}$$

here L_i – Wald individual cross-sectional data at time T;

$\bar{L}$ – Mean value.

The typical normal distribution can look like as following when $\bar{L}$ is independent, identically distributed and Q is the degree of freedom (17).

$$\bar{Z} = \sqrt{\frac{N}{2Q}}\left(\bar{L} - Q\right) \rightarrow N(0,1). \tag{17}$$

At fixed time dimension T, the modified standard normal distribution is shown below (18).

$$\tilde{Z} = \sqrt{\frac{N}{2Q} \times \frac{(T-2Q-5)}{(T-Q-3)}} \times \left[\frac{(T-2Q-3)}{(T-2Q-1)}\bar{L} - Q\right]. \tag{18}$$

Results and Discussion

First, we will apply homogeneity and normality tests to assess the appropriateness of our panel data. The descriptive statistical summary is presented in table 2, where we observe a small standard deviation in our panel data. This outcome suggests that our data exhibit homogeneity and normality characteristics.

Table 2 – Descriptive statistic of the dataset

Variable	Observations	Mean	Std. Dev	Min	Max
LURP	130	17.128	1.759	14.766	20.026
LEPC	130	5.674	0.779	3.802	7.122
LGEF	130	3.539	0.403	2.599	4.195
LGEX	130	23.121	1.634	19.974	26.445
LBM	130	3.986	0.301	3.244	4.835

Note: LURP – urban population; LEPC – electric power consumption per person; LGEF – Government effectiveness; LGEX – Government expense; LBM – Broad money.

The results of the cross-sectional dependency test, as per equation (3), are provided in table 3. From the table, we observe the existence of cross-sectional dependency at a 1 % significance level, except for the government efficiency (LGEF) variable. Additionally, we conducted the CADF and CIPS tests based on equations (4) and (5), respectively.

Table 3 – CD Test Results

Variables	Statistics	p-value	Corr	Abs (coss)
LURP	15.88	0.000	0.985	0.985
LEPC	15.48	0.000	0.960	0.960
LGEF	-0.75	0.454	-0.046	0.412
LGEX	15.62	0.000	0.969	0.969
LBM	10.49	0.000	0.651	0.651

We obtained a mixed order of integration from the results of the CADF and CIPS tests, as presented in table 4. Based on the outcomes from table 4, we can conclude that our variables rejected the null hypothesis at either the level or first difference. This finding allows us to perform the PMG estimation test to examine the short and long-run relationships. The results of the PMG estimation are shown in table 5.

Table 4 – CADF and CIPS test results

Variables	CADF Test		CIPS Test	
	Levels	First Difference	Levels	First Difference
LURP	-2.709***	-1.409	-2.857***	-1.872
LEPC	-2.084	-3.360***	-2.107	-5.285***
LGEF	-1.788	-3.272***	-2.621***	-5.544***
LGEX	-2.612***	-3.454***	-2.585***	-4.542***
LBM	-1.548	-2.724***	-1.390	-4.105***

*Note: ***indicates 1 % level of significance.*

Our first independent variable, access to electricity (LEPC), displays a positive and statistically significant relationship at the 1 % level in the long-run case. This implies that cities have developed over time, and access to electricity not only plays a crucial role in expanding the size of the city but also contributes to enhancing the available facilities for urban residents in the future. He (2020) also identified a long-run relationship between electricity consumption and urbanization in his study [21]. Besides electricity access, government expenses show significance only in the short run, while government effectiveness shows significance at the 1 % level with a negative sign in the long-run case only. The main reasons behind these findings are likely related to issues such as corruption, task quality, and the skill level of government employees in South Asia. Finally, the variable of broad money indicates a negative sign with 1 % significance in the long run only. This implies that existing factors in this region, such as inflation, lack of monetary policy, corruption, and others, affect the urbanization process over time.

Table 5 – PMG estimation

Variables	Long run test		Short run test	
	Coefficient	Prob.	Coefficient	Prob.
LEPC	0.157*** (0.022)	0.000	0.005 (0.004)	0.295
LGEF	-0.059*** (0.018)	0.002	0.001 (0.001)	0.225
LGEX	-0.005 (0.025)	0.836	0.006*** (0.002)	0.009
LBM	-0.204*** (0.043)	0.000	-0.001 (0.002)	0.567
Error correction coefficient	0.018 (0.023)	0.435		

*Note: ***indicates 1 % level of significance.*

Our final analysis involves the Granger causality test to examine the causal relationships, and the results are presented in table 6. Among the four independent variables, three of them show a bi-directional relationship with urbanization, indicating a reciprocal influence between these variables and the urbanization process. However, broad money exhibits a unidirectional relationship, suggesting that it influences urbanization, but urbanization does not significantly influence it in return.

Table 6 – Ganger causality test

Test	W-stat	Zbar stat	Prob.	Findings
LEPC→LUP	5.831	6.296	0.000***	Bidirectional relationship
LUP→LEPC	3.784	3.571	0.000***	
LGEF→LUP	2.399	1.729	0.084*	Bidirectional relationship
LUP→LGEF	2.965	2.482	0.013**	
LGEX→LUP	5.881	6.363	0.000***	Bidirectional relationship
LUP→LGEX	10.076	11.946	0.000***	
LBM→LUP	8.019	9.207	0.000***	Unidirectional relationship

Conclusion

The main objective of this paper was to investigate the role of electricity and government policies in the urbanization process of five South Asian countries. The study delved into variables such as electricity consumption, the number of urban populations, government expenditures and efficiency, and monetary policies over a specific period. Through a series of diagnostic tests (CD, Co-relation, co-integration, panel causality test, etc.), we established a causal relationship between urbanization and the aforementioned variables in long-run analyses.

Among these variables, electricity consumption emerged as a crucial factor with a significant impact on urbanization in the long run. However, government policies, including expenditures, employees' effectiveness, and broad money, might act as limiting factors in the urbanization process for the South Asian countries. Therefore, enhancing the organizational structure and implementing development projects and policies for urban areas, powered by electricity, could lead to the creation of better and healthier cities.

Policymakers should address these issues to facilitate sustainable urban development and ensure a better quality of life for the population of the South Asian region. By tackling challenges related to governmental expenditures, improving the effectiveness of government employees, and amplifying the role of electricity in urban planning and infrastructure development, policymakers can pave the way for a future characterized by sustainable urbanization and improved living conditions.

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