

# Impact of Electricity Production on GDP growth and Poverty: A case study on Bangladesh

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**Abstract.** This paper investigates the effect of electricity production on GDP growth and poverty in Bangladesh considering a computable general equilibrium model (CGE) via GTAP-POV framework. As Bangladesh targets to be a middle income country from a low income country by 2021, GDP growth and reducing poverty are the crucial factors to achieve that goal. Hence, one of the ways can be increasing the GDP growth by increasing the production of electricity. By calculating the electricity production requirement, it is found that, by increasing a 25% electricity production, it is possible to increase the GDP growth of Bangladesh by 1%. However, the results suggest that, whenever there is an increase in electricity production, there is increase in output in non-agricultural sectors. Furthermore, the skilled workers in the economy become more beneficial and performs better considering the reduction of poverty. A robustness check has been conducted by reducing the tax on electricity and it suggests similar results.

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## I Introduction

In low income countries like Bangladesh, access to electricity is a burning issue due to its less electricity production capacity and dependence on electricity import. In several research works on developing Asia, it was found that, the electrification policy helped to reduce income poverty in rural areas of those countries (Barnes et al., 2011; Pachauri et al., 2004). A study by Pereira et al.(2011) also suggested similar result for electrification policy regarding Brazilian household. However, it was found that, economic development and reduction of poverty depends significantly on the access of modern electricity (Pereira et al., 2010). Furthermore, several researchers suggested that, using electricity during evening hours can extend work and study hours which contribute to household productivity, education and help to reduce the income poverty (Cabraal and Barnes, 2006; Saunders et al., 1975; Sachs, 2005; Wasserman and Davenport, 1983; World Bank, 2002c). However, as the GDP of Bangladesh depends on agricultural production along with production of ready made garments, access and production of electricity is very important for the country's growth. On the other hand, as Bangladesh targets to become a middle income country via increasing GDP growth and reducing income poverty by 2021, the government of Bangladesh has started to consider electricity production more seriously. However, it has been found that, to become a middle income country, it is important to have a GDP growth of at-least 8% along with a poverty headcount of 14.5% (Gimenez et al., 2013) . Hence, with the current GDP growth and economic condition of the country, one of the ways to increase the GDP growth is by increasing the production of electricity. By calculating the electricity production requirement, I found that, by increasing a 25% electricity production, it is possible to increase the GDP growth of Bangladesh by 1%. This certain feature motivated me to conduct this research. Therefore, considering a computable general equilibrium

(CGE) model via using GTAP-POV framework, I examined the effect of electricity production on GDP growth and poverty of Bangladesh. The results show that, whenever there is an increase in electricity production, there is increase in output in non-agricultural sectors. Furthermore, the skilled workers in the economy become more beneficial and performs better considering the reduction of poverty. A robustness check has been conducted by reducing the tax on electricity and it suggests similar result.

The rest of the paper proceeds as follows: Section I discusses about the model. Section II explains the results and the analysis. Section III concludes.

## **II The Model**

A computable general equilibrium (CGE) model has been used within the framework of GTAP-POV for the experiments and analysis of electricity production effect on GDP and poverty. GTAP-POV is an extension of GTAP where a poverty module had been nested within the GTAP modeling framework where it is possible to assess the impact of global trade, environment and energy policies on poverty (Hertel et al., 2015). Furthermore, the model incorporates AIDADS demand system, additional tax placement instruments, factor supply and demand features from GTAP-AGR. Therefore, I conducted two experiments to examine the effect on GDP and poverty by giving a positive electricity production shock and a tax cut on electricity. The experiments are explained in the sub-sections.

### **II.I Experiment 1: Electricity Production Shock**

The economic growth of Bangladesh is largely dependent on the domestic agricultural sector and the ready made garments export. Along with these two major sectors, other production sectors have high dependency on electricity production.

However, it is found that, GDP growth and electricity production growth has a positive correlation in Bangladesh. Hence, from the calculation, to increase the GDP growth of Bangladesh by 1% due to an increase in electricity production only, it is important to increase electricity production by 25%. Therefore, I used a 25% increase in electricity production as a shock<sup>1</sup> to analyze the effect on other agricultural and non-agricultural sectors production. Furthermore, effects on income for skilled and unskilled workers of different sectors are also analyzed to measure the effect of this shock on poverty reduction. All these analysis are done within the GTAP-POV framework.

## II.II Experiment 2: Shock on Electricity Tax

Experiment two is done to check the robustness of Experiment 1. Here, it is assumed that, a one percent decrease in electricity tax causes a one percent increase in electricity production<sup>2</sup>. Using this strong assumption of one to one relationship between tax and production of electricity, I used a 25% tax cut on electricity production as the shock<sup>3</sup> in this experiment. As our target is to check the robustness of the results obtained in Experiment 1, the effects on agricultural and non-agricultural sectors production are again examined. Effects on unskilled and skilled labor income are also analyzed to check the effect on the poverty condition after the shock.

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<sup>1</sup> The shock is given to “Utility” which incorporates electricity production. In GTAP-POV, Utility is an element of variable “qo”. Here, “qo” suggests the industry output of commodity i in region r.

<sup>2</sup> This assumption is considered because, a decrease in electricity tax is supposed to increase electricity use by production sectors and causes an increase in aggregate output. Hence, the government gets more fund to produce more electricity.

<sup>3</sup> The shock is given to Utility which is an element of variable “tfd”. Here, “tfd” refers to tax on domestically produced commodity i purchased by firm j in region r.

### III Results and Analysis

#### III.I Effect of Electricity production shock

Table 1 reports the changes in production of different agricultural and non-agricultural products due to an increase in electricity production by 25%. Even though, Bangladesh is a country dependent more agricultural sectors, due to less use of electricity driven technology in agriculture, changes in agricultural output is very minimal. Among the crops, only rice production increases by 0.265% where as wheat production decreases by 2.66%. One of the possible reasons of this drop can be labor migration from agricultural industry to the manufacturing industry.

On the other hand, in manufacturing sector, the heavy manufacturing industry's output increases by 3.81% where as the textile industry production drops by 6.71%. The reasons behind this can be, as the heavy manufacturing is more dependent on electricity, due to electricity production increase, heavy manufacturing sector produces more, hires more labor with a better competitive wage, thus inter-sectoral migration takes place from textile to heavy manufacturing industry.

**Table 1.** Sectoral production change for Electricity production shock

Sector	Rice	Wheat	Other crops	Textile	Heavy manufacturing	Other manufacturing
<b>% Change in production</b>	0.265	-2.66	0.013	-6.72	3.81	0.484

Table 2 reports the effect of the electricity production shock on the real income (on poverty line) and on poverty<sup>4</sup>. However, the results suggest that, in both agricultural and non-agricultural sectors, the unskilled labors real income

<sup>4</sup> Here, POV 1 refers to the extreme poverty line based on \$1.25/day income. POV 2 refers to international poverty line base on \$2/day income.

decreases and they are becoming more poverty stricken. However, the skilled labors only in non-agricultural sectors are having a 0.144% increase in their income where as the agro-sectors skilled workers are having a decrease of 1.11% in their income. This certain change can be linked with the migration of agro sector labors to the non-agro sector.

**Table 2.** Effect of Electricity production on real income

<b>Labor type</b>	Ag-Unskilled	Ag-Skilled	Nonag-Unskilled	Nonag-Skilled	Wg-Unskilled	Wg-Skilled
<b>POV 1</b>	-1.44	-1.11	-0.174	0.144	-0.523	0.144
<b>POV 2</b>	-2.36	-1.48	-1.15	-0.218	0.1	-0.566

However, I decomposed the real income on poverty line for both the agro and non-agro sectors<sup>5</sup>. Table 3 suggests the decomposition of real income for unskilled workers of non-agro sector<sup>6</sup>. It is found that, there is increase in price (i.e. pmagr) of the products produced by agro sector which contributes to have a higher income to them but due to a larger effect of income tax power (i.e. PINCTAX) and true cost of living (i.e. True cost), the total effect on income is negative considering both the poverty lines. Table 4 explains similar results for the skilled labors in the agro-sector where the price level of the products even though increased, its effect is dampened by the tax and true cost of living. Hence, they are worse-off considering the poverty line income<sup>7</sup>.

Table 5 and Table 6 explain the non-agro sector's unskilled and skilled workers income effected by the different factors respectively. It is found that, the unskilled workers and skilled workers income even though increase due to an

<sup>5</sup> Defined as "povinc".

<sup>6</sup> The equation here is,  $povinc(p, "AgUnskl", r) = pmagr("UnskLab", r) + PINCTAX * ato("UnskLab", r) - truecost(p, r)$ .

<sup>7</sup> Equation,  $povinc(p, "AgSkl", r) = pmagr("SkLab", r) + PINCTAX * ato("SkLab", r) - truecost(p, r)$ ;

**Table 3.** Factors effecting Income (Agro-Unskilled) on Poverty line

Variables	Poverty Lines	
	POV 1	POV 2
pmagr	0.724	0.724
PINCTAX	-0.905	-0.905
Truecost	-1.27	-1.32
Total	-1.45	-1.5

**Table 4.** Factors effecting Income (Agro-Skilled) on Poverty line

Variables	Poverty Lines	
	POV 1	POV 2
pmagr	1.06	1.06
PINCTAX	-0.905	-0.905
Truecost	-1.27	-1.32
Total	-1.12	-1.16

**Table 5.** Factors effecting Income (Nonagro-Unskilled) on Poverty line

Variables	Poverty Lines	
	POV 1	POV 2
pmnagr	2.02	2.02
PINCTAX	-0.905	-0.905
Truecost	-1.27	-1.32
Total	-0.158	-0.203

**Table 6.** Factors effecting Income (Nonagro-Skilled) on Poverty line

Variables	Poverty Lines	
	POV 1	POV 2
pm	2.34	2.34
PINCTAX	-0.905	-0.905
Truecost	-1.27	-1.32
Total	0.168	0.123

increase in price of the products produced by that sector, unskilled workers true cost of living and cost of tax causes them to have a percentage decrease in their income<sup>8</sup>. On the other hand, only the skilled workers are benefited here as the

<sup>8</sup> Equation,  $povinc(p, "NagUnskl", r) = pmnagr("UnskLab", r) + PINCTAX * ato("UnskLab", r) - truecost(p, r)$

price increase of the products is higher here which increases their income<sup>9</sup> higher than the true cost of living and cost of tax.

### III.II Effect of Electricity Tax cut

In this section, I considered the tax cut on electricity usage as the shock to check the robustness of the results of Experiment 1. Table 7 reports the effects of the tax cut where we can find similar results for the agro-sector. In non-agro sector, the textile industry is growing by 0.068% which suggests that they are getting higher benefits due to a tax cut in electricity usage. Other manufacturing industries are also having production increase by 0.057%. Interestingly, production of utility is decreasing.

**Table 7.** Sectoral production change for tax cut on Electricity

Sector	Rice	Wheat	Other crops	Textile	Heavy manufacturing	Other manufacturing
<b>% Change in production</b>	-0.005	0.049	0.006	0.068	-0.18	0.057

Table 8 suggests similar result of Experiment 1. However, due to tax cut on electricity, income of skilled workers in both sectors are increasing in this case. Hence, skilled workers are more likely to come out from the poverty due to this shock.

**Table 8.** Effect of Electricity tax cut on real income

Labor type	Ag-Unskilled	Ag-Skilled	Nonag-Unskilled	Nonag-Skilled	Wg-Unskilled	Wg-Skilled
<b>POV 1</b>	0.016	0.012	-0.004	0.007	0.002	0.007
<b>POV 2</b>	0.17	0.013	-0.003	0.006	0.002	0.006

After decomposing the real income of the skilled and unskilled workers of both the sectors, it is found that the price increase of the goods produced helps

<sup>9</sup> Equation,  $\text{povinc}(p, \text{NagSkI}, r) = \text{pmangr}(\text{SkLab}, r) + \text{PINCTAX} * \text{ato}(\text{SkLab}, r) - \text{truecost}(p, r)$

to have a positive income growth of the skilled workers and dampens the effect of the increasing true cost of living. The results are reported in Table 9, 10 and 11 respectively. Here, the power of income tax had been considered zero by the model itself.

**Table 9.** Factors effecting Income (Agro-Skilled) on Poverty line

Variables	Poverty Lines	
	POV 1	POV 2
pmnagr	-0.045	-0.045
PINCTAX	0	0
Truecost	0.057	0.058
Total	0.012	0.012

**Table 10.** Factors effecting Income (Nonagro-Unskilled) on Poverty line

Variables	Poverty Lines	
	POV 1	POV 2
pmnagr	-0.061	-0.061
PINCTAX	0	0
Truecost	0.057	0.058
Total	0.004	0.003

**Table 11.** Factors effecting Income (Nonagro-Skilled) on Poverty line

Variables	Poverty Lines	
	POV 1	POV 2
pm	-0.064	-0.064
PINCTAX	0	0
Truecost	0.057	0.058
Total	0.007	0.006

However, it can be noticed that, the utility (i.e. electricity) production is decreased due to the tax cut. Therefore, checking the import of utility after this

shock suggests that, utility import increases by 0.172%. Table 12 reports the changes in major imports. Other imports, such as wheat and textile decreases due to the increase in production in these two industries. Rice import decreases due to an increase in dependency on wheat.

**Table 12.** Change in import

<b>Goods</b>	Rice	Wheat	Textile	Utility
<b>% Change in import</b>	-0.159	-0.006	-0.014	0.172

## IV Concluding Remarks

This paper demonstrates that, if Bangladesh targets to increase the GDP growth by 1% via increasing the electricity production, it is possible by increasing electricity production by 25% considering the current economic growth. The analysis here shows that, increasing electricity production mostly increase the output in the non-agro sector along with increasing the real income of the skilled labors. Hence, the skilled labors are better off and poverty is reduced for this certain class of labors. On the other hand, if a tax cut on electricity usage is introduced rather than the production increase, similar results are observed considering output growth along with real income increase and poverty reduction. However, due to the tax cut, it is found that, the production of electricity decrease and the country becomes more dependent on electricity import.

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