Sectoral Heterogeneity in the Temperature Effect on Poverty and Inequality

Group name: Pa Gumi
Student names: Haruki Hidaka, Jiangrui Kang, Reika Arai, Saki Takikawa, Takuma Komaba
Name of instructor: Shun Chonabayashi

Soka University, Faculty of Economics, Chonabayashi Seminar

Keywords: “Climate change”, “Temperature”, “Poverty”, “Inequality”, “Sector”

1. Introduction

In recent years, global warming has become an urgent international issue. The earth’s surface temperature rose more rapidly from 2011 to 2020 than in any 50-year period in the past 2,000 years (Lee et al., 2023). Furthermore, approximately half of the world's population lives on less than $6.85 per day, and the Gini index increased by 0.5 points in 2020 (World Bank, 2022). The rise of temperature and issues of poverty and inequality are closely interconnected. Dang et al. (2023) states that rising temperatures impact poverty and inequality. Additionally, the effects of temperature changes are larger in countries with a higher share of agriculture and weaker in countries with a higher share of manufacturing (Dang et al., 2023). Therefore, we analyze the sectoral impact of the temperature increase by classifying all sectors into 10 categories. This research is relevant to Sustainable Development Goal (SDG) 1, “End poverty of all its forms everywhere,” and SDG 13, “Take urgent action to combat climate change and its impact,” as it contributes to the achievement of these international goals.

2. Empirical Specification

In this study, we conduct a multiple regression analysis using a fixed-effect model with the following equations in order to determine in which countries poverty and inequality are affected by rising temperature.

Equation

$$Y_{i,t} = a_{i,t} + f(T_{i,t}, D_{j,i,t}) + g(P_{i,t}, D_{j,i,t}) + \theta_i + \pi_t + \varepsilon_{i,t}$$

$$f(T_{i,t}, D_{j,i,t}) = b_1(T_{i,t}) + b_2(T_{i,t}^2) + \beta_{1j}(T_{i,t} * D_{j,i,t}) + \beta_{2j}(T_{i,t}^2 * D_{j,i,t})$$

$$g(P_{i,t}, D_{j,i,t}) = c_1(P_{i,t}) + c_2(P_{i,t}^2) + \gamma_{1j}(P_{i,t} * D_{j,i,t}) + \gamma_{2j}(P_{j,i,t}^2 * D_{j,i,t})$$

where $Y_{i,t}$ represents the first differences in the poverty and inequality rates in country i in year t. $T_{i,t}$ represents the annual average temperature variable. $D_{j,i,t}$ is a sector dummy variable that takes 1 if the share of the j sector in GDP is equal to or greater than the sample median. We control for precipitation ($P_{i,t}$). $a_{i,t}$ is the constant term, θ_i is the fixed effect for each country, πt is the fixed effect for each year, and $\varepsilon_{i,t}$ is the error term. This equation is used to analyze in which sectors poverty and inequality are more or less affected by rising temperatures. The descriptive statistics and data sources of the variables used are shown in Table 1 below.

3. Results and Discussion

Table 2 shows the marginal temperature effect for the sector dummy variables on poverty and inequality evaluated at the mean. The P-values of industrial

dummies for poverty rates are below 10% significance. Others are not below 10% significance.

According to the results, countries with a high GDP share of industrial sectors are more affected by temperature increase. There are three reasons that others are not significant. Firstly, we use developed countries' data. Secondly, we use short-term mode. Lastly, other sectors are not affected by rising temperatures. Figure 1 illustrates the effect of annual average temperature on poverty and inequality, with the shaded region indicating a 90% confidence interval. We consider that this uncertainty can impact the economy and potentially contribute to increasing inequality because the confidence interval widens as temperature increases. However, we also consider less numbers of sample observations used as temperature becomes high and low.

4. Conclusion

We conduct an analysis to investigate the varying impacts of temperature increase across different sectors. As a result, we find heterogeneous effects. Temperature increase has a bigger impact on poverty in countries with high industrial share in GDP. Also, we find that other sectors are less affected by rising temperatures.

Table 1: Descriptive Statistics and Data Sources of Variables Used

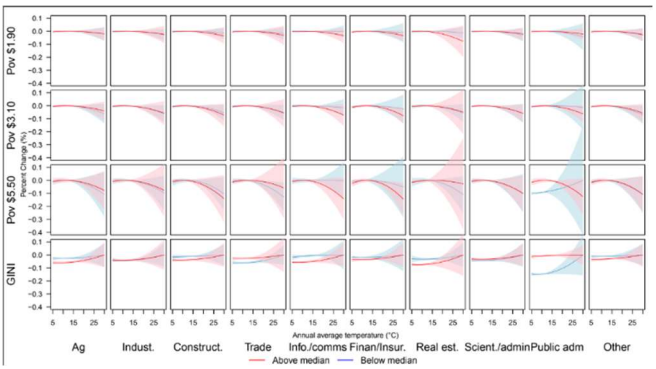
Variable	Obs.No.	Mean	S.D.	Min	Max
Poverty rate (%) and inequality (2003-2019)					
Source: The World Bank - https://www.worldbank.org/en/home					
Poverty rate $1.9	1318	0.067	0.139	0	0.915
Poverty rate $3.1	1318	0.143	0.221	0	0.976
Poverty rate $5.5	1318	0.284	0.309	0	0.997
GINI Index	1318	0.368	0.081	0.232	0.648
Satellite weather data (2003-2019)					
Source: International Energy Agency - https://www.iea.org/					
Annual Average Temperature (C)	4029	19.704	7.916	-8.762	29.337
Annual Average Pricipitation (mm/h)	4029	0.139	0.094	0.001	0.566
Share of each industries in GDP (%) (2003-2019)					
Source: OECD Statistics - https://www.oecd.org/					
1:Agriculture	1003	0.044	0.049	0	0.298
2:Industy	1003	0.195	0.076	0.022	0.627
3:Construction	1003	0.056	0.019	0.01	0.16
4:General Services	1003	0.185	0.044	0.063	0.363
5:Information and Communication	977	0.041	0.014	0.016	0.142
6:Financial and Insuarance	994	0.055	0.038	0.011	0.268
7:Real Estate	983	0.086	0.028	0.027	0.193
8:Professional Services	936	0.073	0.026	0.009	0.149
9:Education and Human Health	986	0.149	0.032	0.061	0.227
10:Other Services	943	0.031	0.028	0.007	0.231

Table 2: Marginal Temperature Effect for the Sector Dummy Variables on Poverty and Inequality

	Poverty1.9	Poverty3.1	Poverty5.5	GINI	Obs.No.
1	-0.006	-0.0065	-0.0742	0.0406	355
2	0.0535*	0.0862**	0.1736**	0.0728	355
3	-0.0089	-0.0118	-0.0105	0.0525	355
4	0.0513	0.0313	0.17	-0.1418	355
5	-0.046	-0.1166	-0.1102	0.053	352
6	0.0436	0.0788	0.0913	-0.0569	355
7	0.0075	0.0194	0.0511	0.0465	355
8	0.0031	0.0105	0.0382	0.0441	352
9	0.0009	0.0671	0.15	0.0736	352
10	-0.0003	-0.0239	-0.0395	-0.0378	355

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$, Marginal effect evaluated at the mean

Figure 1: Effect of Annual Average Temperature on Poverty and Inequality



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