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REM621

Assignment 3: Parts 1 & 2

You've been asked by an intergovernmental organization to help make an economic case for environmental protection. One question in particular is whether there is a relationship between indicators of environmental protection for different countries and their economic performance measured by GDP per capita. You're not too sure, but it's worth exploring. Using the dataset provided:

1. Provide a 2-3 paragraph critique of the indicators for environmental protection, social equity, and GDP per capita and what their limitations might be in terms of meaningfully representing national trends or relationships between social well-being and environmental sustainability (include references).

The indicators for Environmental Performance Index (EPI), Social Equity (SE), and GDP per capita (PPP) might be limited in their representation of social well-being and environmental sustainability and the relationships between them due to challenges in their scoping.

In the case of EPI, the indicators used for its calculation can be both too narrow and too broad in their scoping, and therefore could misrepresent social well-being and environmental sustainability on their own. There was a total of 40 indicators developed for EPI, many of which were very broad in their scope or had a narrow scope due to limited data. For instance, air quality indicators (PMD, HAD, OZD, etc.) and sanitation indicators (USD & UWD) were all standardized using age-standardized disability-adjusted life-years lost per 100,000 persons in a given country (DALYs) and thus may not capture localized pollution within countries (Wolf et al., 2022). This scope of these indicators could miss more localized impacts, thereby misrepresenting social well-being. The indicators for habitat loss (TCL, GRL, WTL) all have relatively limited timescales to describe loss. These all were quantified using a five-year moving average of percentage of gross losses in areas since the reference year, the oldest of which dated back to 1992. Therefore, the indicators for habitat loss may not capture the loss and has undoubtedly occurred prior to the late 19th century, thereby misrepresenting environmental sustainability.

The contributing indicators for SE may not reflect the full picture of social inequities, especially for underrepresented groups such as First Nations and Indigenous peoples, in turn misrepresenting understandings of social well-being. For example, the Fragile States Index indicators have been used as indicators for SE, and some of them may lack a scope that accurately represents the historical and ongoing impact of colonialism (Cisneros-Montemayor et al., 2021; Messner et al., 2018). Within the Fragile States Indicator for Group Grievance, there are many questions that outline the scope of the indicator, such as those for Post-Conflict Responses. Within the Post-Conflict Response questions, many address whether or not a response to conflict has been initiated at the national scale (e.g. “Does a Truth & Reconciliation process exist or is one needed?”), but none of the questions in this category bring into consideration the spatial scale of this question and its variance across groups over time. Further, because the data for each of the Fragile States indicators are sourced and coded from media articles, reports, and quantitative datasets, which are primarily representative of Western values, they might not accurately represent the issues pertinent to indigenous communities.

PPP does not have contributing indicators that makeup its metric like the indicies above, therefore I will be critiquing PPP as an indicator overall. According to The World Bank Metadata Glossary, GDP per capita or PPP is “the sum of gross value added by all resident producers in the economy plus any product taxes (less subsidies) not included in the valuation of output, divided by mid-year population” (2023). Though the calculation for PPP is straight forward, there are many issues in its representation of social well-being. The biggest one (which we discussed in class) is that PPP does not consider natural disasters impact on social well-being, and instead falsely indicates improvements in social well-being. PPP is generally inflated following disasters due to rebuilding efforts (Cavallo et al., 2010). PPP does not reflect the net loss in capital from these events and nor the loss resources and quality of life. Altogether, this shows how PPP can be a misleading metric of social well-being.

1. Use regression models to test whether there is a correlation between GDP per capita and environmental protection. Also, test whether there is a correlation between the social equity indicator and GDP per capita. (You can do this using multiple regression, or just a second regression analysis.) Show your results in graphs and include a short (1-2 paragraph summary) of your findings.

A graph with lines and numbers

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Figure 1: Various linear models showing GDP per capita’s (PPP) impact on Environmental Performance Index (EPI) and Social Equity (SE), and the combination of EPI and SE. Each colored line represents the regression model PPPs influence on each index (SE = Red, EPI = Blue, EPI + SE = Purple), with their corresponding R-squared values in same color of text at the end of the line, indicating the proportion of variance explained by PPP for each index or their combination.

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| --- | --- | --- | --- | --- | --- |
| Model | Coefficient Estimate (GDP.per.capita.PPP) | Std. Error (GDP.per.capita.PPP) | t-value (GDP.per.capita.PPP) | p-value (GDP.per.capita.PPP) | R^2 |
| Environmental Performance Index | 2.49E-04 | 1.23E-04 | 2.02 | 0.053 | 0.1272 |
| Social Equity | 6.98E-04 | 2.06E-04 | 3.389 | 0.0021 | 0.2909 |
| Environmental Performance Index + Social Equity | 9.47E-04 | 2.89E-04 | 3.277 | 0.0028 | 0.2772 |

**Table 1**: Summary table of the linear models (Figure 1) describing GDP per capita’s (PPP) influence on Environmental Performance Index (EPI), Social Equity (SE), and their combination (EPI + SE). Each column shows the coefficient estimate, standard error, t-value, and p-value for PPP across the three separate linear models for each index and their combination. The final column indicates the R-squared values for each model, which describes the variance in dependent(s) variable explained by PPP.

The regression summaries in Figure 1 and Table 1 show a weak but positive relationship between GDP per capita (PPP) and Environmental Performance Index (EPI), Social Equity (SE), and their combination (EPI + SE), with varying levels of certainty. Only ~12.72% of the variation in EPI can be explained by PPP, with a near threshold p-value of 0.053. Comparatively, SE had a stronger relationship with PPP, with 29.09% of the variation in SE is explained by PPP, and highly significant p-value of 0.0021. Finally, when EPI and SE are combined as dependant variables, PPP explains 27.72% of the variance and has a significant p-value of 0.0028.

The unanimous weak yet positive correlations between increasing PPP and each respective index (EPI, SE, and EPI + SE) suggests that countries with a higher PPP tend to have better SE and EPI. These positive relationships could be due to the more resources that are available for environmental protection and social programing in wealthier countries. For example, the Kuznets Curve (EKC) hypothesis is a longstanding theory that environmental conditions get worse and then improve as economic growth increases. Many factors are suggested to contribute to this relationship, and many are controversial, such as the increase in technological innovation as a by-product of economic growth, which some propose contribute to CO2 emission reductions whereas others suggest they don’t (Chen & Lee, 2020). It is important to note, that the stronger relationship between SE and PPP suggests that the factors tied to SE might be more influenced by economic growth in comparison to those tied to EPI. All this said, the relatively weak R-squared values between PPP and each of the indices suggests that substantial amount of their variation is explained by other variables.

**References**

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