Jewelry Development Impact Index: Standardization and Analysis

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Key Terms and Abbreviations

Jewelry Development Impact Index (JDI Index)/(JDII)

Resource Governance Index (RGI)

World Governance Index (WGI)

Human Development Index (HDI)

Gross Domestic Product (GDP)

Environmental Performance Index (EPI)

Sustainable Development Goals (SDG)

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Executive Summary

The worldwide jewel industry is unpredictable and profoundly divided, composed of various trades on an open market enterprise, a huge number of small, secretly held organizations, and government substances. Sourcing of crude materials and the creation of completed gems effectively affects the economies of host nations. These exercises are frequently situated in a portion of the world's most weak social order. Jewelry Development Impact (JDI) Index is a scoring mechanism which was developed to compare the countries in terms of their jewelry industry based on five components: Governance, Economy, Human Health, Environment and Human Rights.

The jewelry industry can profit from provinces (host country) and local communities by creating jobs, improving local revenue, and offering social services. In any case, these industries additionally can hurt countries' as mining can harm the local environment, cause constant medical issues for miners and residents of mining communities, and conceivably present difficulties to human rights.

This report presents the research findings of the seventh team of graduate students from the University of Delaware. Our aim is to validate the index using various analysis techniques to develop a more robust final deliverable product. With an attempt to validate the data, our hope is for a widespread use of this index where knowledge about different segments of the jewelry industry can be found all in one place i.e., be all inclusive. In accordance to the statement of work, we also reviewed the JDI methodology, scoring system and questionnaire prior to using business analytical tools to validate the data.

Components of Jewelry Development Impact (JDI) Index

JDI Index comprises of five components: Governance, Economy, Environment, Human Right and Human Health where each of these components have been divided into further sub-components. Governance component explores accountability mechanism, transparency, corruption prevention, industry regulation, and criminal organization/ non-state actors; Economy component explores industry employment, fiscal sustainability, beneficiation, smuggling, and the informal economy, criminal non-state actors, and terrorist funding, supply chain; Environment explores environmental regulatory stringency and enforcement, existence and extent of pollution, risk to biodiversity, post-production planning and remediation; Human Right component explores workers' rights,

indigenous/ ethnic group rights, women's rights, children's rights, freedom from violence; Health component explores human health, food security, water security.

Standardization Process

The report means to add to advancement of the proof-based measurement to evaluate the degree of reliability of the Jewelry Development Impact (JDI) Index. Continuing the work of the previous teams, our team compared the question sets from the previous years for a total of 10 countries and identified a difference of approximately 7 questions between the old and the latest questionnaire. Using the same scoring methodology as previous groups, our team conducted an in-depth research on each of those questions and scored countries accordingly. The identified questions were scored on a 1-7-point Likert scale (1 indicates constant risk or low to no probability of an incident taking place and 7 indicated little to no risk or high probability of an incident taking place). The reason we believe standardization of the index is important is to avoid any biases that may or may not impact the model, i.e., standardization of the model gives equal weight to all the components thereby increasing reliability.

Validation Process

In order to validate the data after the standardization process, the analyst team made the decision to utilize construct validity measure. Construct validity refers to the degree to which inferences can legitimately be made from the operationalizations in your study to the theoretical constructs on which those operationalizations were based (Trochim W, 2020). It is usually verified by comparing the test to other tests that measure comparable qualities to identify the correlation between the factors. For example, one way to demonstrate the construct validity of the governance component of JDI Index is by correlating the outcomes on the test to those on the other widely accepted measures of governance. Based on the idea of construct validity measure, the analyst team decided to run a correlation analysis and regression analysis.

For our analyses, the comparable indices that were finalized are Resource Governance Index (RGI), World Governance Index (WGI), Human Development Index (HDI), GDP Per Capita, percentage of GDP from mining, Environment Performance Index (EPI) and Sustainable Development Goals (SDG). The division of these indices are as follows: Resource Governance Index (RGI), World Governance Index (WGI), Human Development Index (HDI) and GDP Per

Capita for the Governance component; percentage of GDP from mining and GDP Per Capita for the Economy component; Environmental Performance Index (EPI) and Human Development Index (HDI) for the Environment component; Human Development Index (HDI) and Education Index for the Human Right components; Sustainable Development Goals (SDG) and Life Expectancy for the Human Health component.

For the correlation analysis, we compared the level of correlation of the associated JDII component with the individual comparable indices. Based on the results from this correlation analysis, our team decided to carry out multiple regression analysis. Our regression analysis finds that Governance, Economy and Human Right components of the JDII are statistically significant indicating two things: (1) JDII is successful in representing the true depiction of the given country, i.e., it depicts what these JDII components claim to measure; (2) The confidence level of running predictive analysis for additional countries for predicting their associated component scores. Our regression analysis also finds that the Environment and the Health components of JDII are statistically insignificant and therefore possessing a need for both: exploring additional comparable indices and adding or revising questions for these sections.

The real-world data has a lot of variances and even with that the JDI Index seems to be statistically significant for most of its components. Therefore, in accordance with our analysis, we believe that the Jewelry Development Impact Index is truly a suitable index as it presents such a high level of detail and is all-inclusive of the factors that impact the jewelry industry.

INTRODUCTION

The worldwide jewelry industry concurrently represents a danger to the different parties involved. Currently, there is certainly not a widespread tool or model to break down the worldwide jewelry industry's effect on a host country. From Fall 2017 to spring 2020, Graduate students research teams from University of Delaware, Minerals, Materials, and Society Program worked on the comparison of the ten countries based on UN indicators (governance, economy, environment, human right, and human health) and finding the gaps between the ten countries' case studies by partnering with the Graduate students from American University's School of International Services and the U.S. Department of Labor Office of Threat Finance Countermeasures. Between Fall 2017 and Spring 2020, six graduate research teams analyzed the impacts of Gold in Peru and Diamonds in Botswana, Rubies in Myanmar and Lapis Lazuli in Afghanistan, Platinum in South Africa and

Sapphires in Madagascar, Emeralds in Colombia and Zambia, Amethyst in Brazil and Tanzanite in Tanzania, Diamond Mining in Guinea, Sierra Leone and Zimbabwe.

The fall 2020 report by graduate student team from University of Delaware, Minerals, Materials, and Society Program in collaboration with University of Delaware, Business Analytics and Information Management program analyzes the questionnaire prepared and used by previous research teams and addresses the gaps between the questionnaire. Furthermore, the analyst team investigates the need of more relatable questions and additional indices for comparison. The report intends to add to the progression of proof-based measures, called the Jewelry Development Impact Index, to assess the level of peril introduced to human security by factors related to the presence of the significant mineral and gems industries.

JDI Index was developed in 2017 which aims to create a general scoring platform for the global jewelry sector to facilitate comparative socio-economic performance analysis of different countries (JDI methodology). The initial research team identified the human security risks per five United Nations (UN) Human Security Indicators: governance, economy, environment, human right, and human health.

JDI Index is unique in the way that as of now there isn't an all-inclusive tool that dissects the worldwide jewelry businesses' effect on a host nation and JDI Index tries to achieve that. Sourcing of crude materials and the creation of completed gems effectively affects the economies of host nations. This paper will make an attempt to validate the JDI Index basing the analysis on the statement of work, JDII methodology and questionnaire.

LITERATURE REVIEW

BACKGROUND OF JEWELRY INDUSTRY AND MINING INDUSTRY

The jewelry industry has been developed for thousands of years. It has grown independently in societies from west to east since ancient times and has gradually evolved into a complex network of markets, which has become globalized. Jewelry has changed from the exclusive product of the nobility and elite to a consumer product that the public can afford. With the high demand of jewelry all over the world, the jewelry market size is anticipated to witness significant growth over the forecast period (Grand View Research, 2019).

The jewelry industry's factors include raw materials of the precious metals and stones and people who mine, forge, and sculpt them, which are sourced from different countries. In order to excavate more raw materials, such as platinum and diamond, for the production of jewelry, the metals, minerals, mining industry develop rapidly, particularly in emerging economies. In other words, the jewelry industry is strongly related with the metals, minerals, and mining industry.

The metals, minerals, and mining industry are characterized as exercises associated with locating, excavating, and processing metals, minerals, and other geological resources that are required in the economy. The industry contains five fundamental sections: 1) Oil and gas extraction, 2) Coal mining, 3) Metal ore mining, 4) Non-Metallic mineral mining, 5) Support Activities for mining.

Mining industries give a considerable lot of the crude materials for hardware we utilize every day, such as silicon and iron, and for precious metal, such as platinum and gold. To show up here, metal mining consistently expanded throughout the long term, with incidental "surges" for a few minerals (silver, gold, radium, and so forth) in regard to impacts mainstream. The basic mining practice until as of late could be summed up in a couple of steps: from getting a permit, burrow the mineral, sell the metal, and, when the store was depleted, walk-away and start another mine somewhere else (Jain et al. 2016; EB 2017). As anyone might expect, mining is among the human exercises with most extensive ecological and social impact.

Moreover, according to the previous case studies, the mining industry and jewelry industry are complex and highly fragmented, particularly in emerging economies. They are made up of a number of publicly traded corporations, thousands of small, privately held companies, and government entities. The sourcing, manufacturing, and trading of raw materials and production of finished jewelry have a significant impact on human security. Additionally, these activities often take place in the world's most fragile and vulnerable societies. The sourcing of raw materials and the production of finished jewelry call for increased study and monitoring to enable the jewelry industry to enhance the positive influence it can have. At present, the international jewelry industry lacks established measures or standards to assess its impact, particularly on sourcing countries. Therefore, building a tool that can be applied to all jewelry-related materials and countries where production, trading and manufacturing occur is required.

COMPONENTS OF JEWELRY DEVELOPMENT IMPACT INDEX

Jewelry Development Impact (JDI) Index is a scoring mechanism which was developed to compare the countries in terms of their jewelry industry based on five components: Governance, Environment, Economy, Human Rights, and Human Health.

1. Governance

It is preposterous to expect to actualize economic improvement of any area without guaranteeing legitimate straightforwardness and responsibility. Control of high-rise brushing land by the mining industry causes a battle in keeping up animals to crowd prompting abbreviated neglected periods (Bebbington and Bury, 2009). It is important to incorporate trust and morals in the administration of the mining, creation, and circulation of gems. Controllers, industry agents, and the work class are three significant partners in the mining and adornments industry and any sort of gap in the correspondence or data stream between them obstructs smooth working of the administrative body (Gunningham and Sinclair, 2009). The job that public government plays in affecting nearby mining populaces is specifically noteworthy. The questionnaire is based on five sub-categories: accountability mechanism, transparency, corruption prevention, industry regulation, and criminal organization/ non-state actors.

2. Environment

The mining and gems making measure is an energy-concentrated cycle that transmits harmful gases as a side-effect. The gold purifying cycle discharges 142 tons of sulfur dioxide every year which is right around 13 percent of the worldwide emanation. Contamination from mining exercises is broad to the point that the world's biggest gold mine called Grasberg dumps 110000 tons of cyanide-bound waste each day into the neighborhood streams. As per the US EPA, metal mining is one of the biggest mechanical polluters in the nation (Bloomfield, 2017). 40% of the U.S. western watershed is adversely influenced by the release from gold mining (Donohoe, 2008). Crude material extraction, just as assembling phases of the adornments, has immediate and backhanded natural outcomes some of which have long haul impacts upon the climate. The questionnaire is based on four sub-categories: Environmental regulatory stringency and enforcement, Existence and extent of pollution, Risk to Biodiversity, Post-production planning and remediation.

3. Economy

Despite the fact that accessibility of common assets is regularly considered as a positive power behind monetary development it has been discovered that nations with less normal assets have

preferable financial development over ingenious nations (Sachs and Warner, 1995). The mining industry has a huge impact on the general public as far as pay, work, schooling level, and so forth Multiplier impact shows around 12 percent commitment of the mining business to the GDP of the nation (Hermanus, 2007).

Despite the fact that in certain locales mining industry caused improved personal satisfaction, past written works likewise talked about the unintended financial outcomes of the mining exercises. As an overall pattern, nations advantage the most from the mining and refining businesses of their particular valuable items yet have frail degrees of beneficiation. Valuable items make up a huge level of the nations' gross domestic product (GDP) and add to the general strength of the economies. Simultaneously, dependence on limited assets can be an unsafe monetary methodology, and illicit mining and fare can give financing to transnational wrongdoing partners or fear-based oppressor gatherings. The questionnaire is based on six sub-categories: Industry employment, fiscal sustainability, beneficiation, smuggling, and the informal economy, criminal non-state actors, and terrorist funding, supply chain.

4. Human Rights

The mining and jewelry businesses have regularly been scrutinized for immediate and circuitous brutal practices. In Cajamarca, 75 percent of the families in 44 networks had to offer their properties to the excavators and moved to bring down height places with less mining exercises (Bebbington and Bury, 2009). Precious stone mining was utilized to take care of cash into the common battle of Sub-Saharan Africa. Poor provincial and indigenous individuals frequently don't have legitimate information on their lawful rights because of which they are regularly abused by rich and politically upheld up diggers. In Ghana, in excess of 30000 individuals were uprooted by gold diggers (Donohoe, 2008). The utilization of hefty instruments and unforgiving working environment conditions presents genuine wellbeing perils, particularly to ladies and kids. The questionnaire is based on five sub-categories: Workers’ rights, Indigenous/ ethnic group rights, women’s rights, children’s rights, freedom from violence.

5. Human Health

Wellbeing effects of the mining exercises are broadly examined issues in the supportability evaluation study. The mining and gems area present ergonomic risks to all people because of utilizing substantial sorts of apparatus and brutal working environment climate. Residue and commotion are basic issues in the mining activity which have expansive effects on human

wellbeing. Information indicated that almost 50% of the labor forces are presented to the stunning commotion in the South African mining industry (Hermanus, 2007). Tuberculosis, HIV, silicosis, and respiratory illnesses are endemic among laborers because of low expectations for everyday comforts and undesirable working environment conditions. The questionnaire is based on three sub-categories: Human health, food security, water security.

STANDARDIZING QUESTIONNAIRE

The report means to add to the advancement of a proof-based measurement, called the Jewelry Development Impact Index, to evaluate the degree of danger presented to human security by factors identified with the presence of the valuable mineral and gems industries. For the analysis, Graduate students of University of Delaware, from Minerals, Materials, and Society Program, in collaboration with Business Analytics and Information Management Program used previous questionnaires for all of the ten countries and updated the questionnaire by adding new questions after research. Expanding upon the work of previous American University graduate student research teams, the report examines the gap between ten countries' questionnaires and made the necessary changes to make a standardized questionnaire for the future analysis. The report additionally proposes updates to the recently utilized strategy just as suggestions to aid the refinement of the approach by future analyst groups.

To understand the degree of danger presented to human security by the valuable mineral and gem industries, the University of Delaware team used indicators of risk created inside the UN's system for human security. These indicators were governance, economy, environment, human health, and human rights. Every indicator consists of different demonstrative sub-indicators and was evaluated through a set of questions that the previous research group arranged depending on writing audit and exploration. These questions were resolved to be heuristic in understanding the dangers with regards to mining in the entirety of the ten countries which were then answered and scored. The index methodology depends on master information to score nations' degree of danger. Previously, questions were scored on a 0-5 scale for eight out of ten countries to give each question and country a similar weight. The most updated questionnaire scores on a 1-7-point Likert scale. The scale goes from zero, representing no risk, to five, representing a very high risk. The accompanying outline shows the scoring utilized.

0	Always or Yes	No Risk
1	Almost Always	Very Low Risk
2	Usually	Low Risk
3	Sometimes	Moderate Risk
4	Almost Never	High Risk
5	Never or No	Very High Risk

The scale goes from one, representing the most horrible condition, to seven, representing the most positive condition. On this scale, a higher score demonstrates that the business isn't making an enormous human security hazard. A lower score demonstrates that the business is making a huge human security hazard. A significant change from previous years is turning around the scale for eight out of the ten countries' JDII question since a large number of the questions were posed such that a high score would show poor performance here when all things considered, it ought to have demonstrated a solid execution or practically no risk. In addition, the analyst team compared the recent questionnaire of Tanzania and Zambia with the other eight countries' questionnaire. After careful analysis, the remaining questions from Tanzania and Brazil question sets were added to the other eight countries' questionnaires for making a standardized questionnaire for future analysis.

0	Not Applicable	Not Applicable
1	Never	Constant Risk
2	Rarely	Very High Risk
3	Occasionally	High Risk
4	Average	Moderate Risk
5	Frequently	Low Risk
6	Very Frequently	Very Low Risk
7	Always	Little to No Risk

CONSTRUCT VALIDITY MEASURE

Validity refers to the state in which the researcher or the investigator can get assurance that the inferences drawn from the data are error free or accurate. If there is validity in the sample, then it is in the population from where that sample has been drawn (Statistics Solutions). Traditionally, there are three types of validity measure: content validity, construct validity and criterion validity. We build our model based on the concept of construct validity. Construct validity has traditionally been defined as the experimental demonstration that a test is measuring the construct it claims to be measuring (Brown J, 2000). The JDII scores from the questionnaire based on JDI Index methodology are the average of 5 components scores. To achieve construct validity, our team ensures that the indicators and measurements are carefully found and developed based on relevant existing knowledge (Middleton F, 2019). Each JDI Index's component is compared with the related JDI Index's indices, which we believe these indexes and measurements are relevant with the main attribute of each JDII component, such as the economy component compared with GDP per capita and percentage of GDP from mining.

In addition, the construct validity of a test should be demonstrated by an accumulation of evidence (Brown J, 2000). Our team takes the unified definition of construct validity and demonstrates it using correlation coefficients, which is correlation analysis, and ANOVA studies demonstrating differences between differential factor analysis, which is multiple regression analysis.

CORRELATION ANALYSIS

Correlation analysis is a statistical method used to evaluate the strength of relationship between two quantitative variables. If it returns a high correlation, it means that two or more variables have a strong relationship with each other, while a weak correlation means that the variables are hardly related. To be specific, it is the process of studying the strength of that relationship with available statistical data. This technique is strictly connected to the regression analysis.

In our analysis, we will focus on correlation coefficient (R) and coefficient of determination (R-squared). R is a measure of the strength of the straight-line or linear relationship between two variables and it takes on values ranging between -1 and +1. A correlation of -1.0

shows a perfect negative correlation, while a correlation of 1.0 shows a perfect positive correlation. A correlation of 0.0 shows no linear relationship between the movement of the two variables. Next, R-squared, represented as a value between 0.0 and 1.0, is a measurement used to explain how much variability of one factor can be caused by its relationship to another related factor. R-squared can let us know how many data points fall within the results of the line formed by the regression equation. The higher the coefficient, the higher percentage of points the line passes through when the data points and line are plotted.

REGRESSION ANALYSIS

Regression Analysis is a statistical technique for studying the relationship between dependent and one or more independent variables. The dependent variable is represented by Y which is the main factor that we are trying to predict, and an independent variable(s) is represented by X which is the factor we suspect has an impact on the dependent variable.

There are three major uses of regression analysis – determining the strength of predictors (X variable(s)) on the dependent variable, forecasting an effect i.e., the regression analysis helps us to understand how much the dependent variable changes with a change in one or more independent variables (*Statistics Solutions*) and trend forecast to get potential point estimates. This analysis includes several variations – linear, multiple linear and nonlinear out of which the most common ones are the simple linear and the multiple linear (*CFI, n.d*).

For the analysis of the components of JDII and comparable indices, we carry out multiple regression. The major difference between multiple regression and simple regression is the number of predictors. The output includes a summary of multiple correlation coefficient, R-squared (coefficient of determination), the adjusted R-squared and standard error of the estimate. The regression analysis (simple and multiple) also gives an output of the ANOVA table which gives us the p-value and significance F. The table also provides other values but for the overall analysis of this model, our focus will be on R-squared and significance F.

From the summary table, R-squared is used to analyze how differences in one variable can be explained by a difference in the second variable. It gives us an idea of how many data points fall within the results of the line formed by the regression equation (*Statistics How To*). A higher R-squared indicates better goodness of fit for the observations. The ideal base for R-squared value

varies from industry to industry. Therefore, we are not setting a base for an ideal R-square for the JDI Index. From the ANOVA table, significance F gives us the probability of our model being wrong. Ideally, we would want the significance F to be smaller than the significance level, for example, if our significance level is 0.05, we would want our significance F to be less than 0.05. The most common significance levels that are used are 1%, 5% or 10% (*Graduate Tutor, n.d*). Statistically, significance F is the probability that the null hypothesis in our model cannot be rejected (*Graduate Tutor, n.d*). The significance F is similar in interpretation to the P-value. The major difference is that the significance F applies to the entire model as a while whereas the P-value is applied to each corresponding coefficient.

Using regression analysis to validate the Jewelry Development Impact (JDI) Index will help represent two things: (1) Extent to which our dependent variable (JDII component) is explained by the independent variables (Comparable Indices). (2) Predict scores by running predictive analysis for other countries which are yet to be scored with 90 to 95 percent confidence (the two significance levels our team will be utilizing).

INTRODUCTION TO COMPARABLE INDICES

JDII focuses on identifying the governance, economic, ethical and environmental performance of the Jewelry industry of the country. Based on JDII methodology and previous research, some related JDII indices were explored to possibly prove the JDI index validity. For our analyses, the comparable indices that were finalized are Resource Governance Index (RGI), World Governance Indicators (WGI), Human Development Index (HDI), Gross Domestic Product (GDP) Per Capita, percentage of GDP from mining, Environment Performance Index (EPI) and Sustainable Development Goals (SDG). This is summarized in the following table:

Component of the JDII	Index(es) for comparison			
Governance	RGI	WGI	HDI	GDP per capita
Economy	% GDP from mining	GDP per capita		
Environment	EPI	HDI		
Human Health	SDG	Life Expectancy Index from HDI		
Human Rights	HDI	Education Index from HDI		

For our analysis, as a first step, we use the Resources Governance Index (RGI) to compare with the JDII component of governance. Resources Governance Index (RGI) is an international index created by the Natural Resource Governance Institute that measures the quality of governance in the oil, gas and mining sectors of 81 countries in 2017. The next index for comparison is World Governance Indicators (WGI) created by the World Bank. It is a research dataset summarizing the views on the quality of governance provided by a large number of enterprises, citizen and expert survey respondents in industrial and developing countries. For the scoring, we choose to utilize 2019 data. Six indicators are included in the WGI, and they consist of Voice and Accountability, Political Stability and Absence of Violence/ Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. In addition, the WGI consists of two scores: Governance Score and Percentile Rank. Governance Score, ranging from -2.5 to +2.5, estimates the governance of each country. Percentile Rank indicates ranks among all countries in the world, and the higher the score is, the higher its rank is. We calculate the average Percentile Rank score of six indicators.

The third index we utilize is the Human Development Index (HDI), created by the United Nations Development Program. HDI is an index that summarizes the achievement in key dimensions of human development, including a long and healthy life, being knowledgeable, and having a decent standard of living. The HDI is the geometric mean of normalized indices for each of the three dimensions: Life Expectancy Index, Education Index, and GNI Index. The data we used from the HDI website is the 2018 data, scored on a 0-1 scale. For the convenience of comparison, we use a linear formula to convert the raw data into our seven-point scale. The last index for our comparison with the governance component is the Gross Domestic Product (GDP) per capita of each country. GDP per capita is a global measure for gauging the prosperity of nations and is used by economists to analyze the prosperity of a country based on its economic growth, and it shows how much economic production value can be attributed to each individual citizen. Alternatively, this translates to a measure of national wealth since GDP market value per person also readily serves as a prosperity measure. As for the GDP percentage from the mining industry, every country has a different percentage. For most countries in our JDI report, mining has helped to shape them to a great extent.

Next, GDP percentage from the mining industry and GDP per capita of each country are used to compare with the economy component of the JDII. We choose the 2019 data for both of these two indexes.

As for the environment component of the JDII, we use the Environmental Performance Index (EPI) for the comparison. The EPI in 2020 ranks 180 countries on environmental health and ecosystem vitality. The scoring indicators provide a gauge at a national scale of how close countries are to established environmental policy targets of the UN Sustainable Development Goals (SDG). The EPI is created by Yale and Columbia University. The other comparing index is HDI.

Furthermore, for the human health component of the JDII, we utilize two different indexes for the comparison: Sustainable Development Goals (SDG) and Life Expectancy Index from HDI. The overall score in SDG measures a country's total progress towards achieving all 17 SDGs. The 17 SDGs are: (1) No Poverty, (2) Zero Hunger, (3) Good Health and Well-being, (4) Quality Education, (5) Gender Equality, (6) Clean Water and Sanitation, (7) Affordable and Clean Energy, (8) Decent Work and Economic Growth, (9) Industry, Innovation and Infrastructure, (10) Reducing Inequality, (11) Sustainable Cities and Communities, (12) Responsible Consumption

and Production, (13) Climate Action, (14) Life Below Water, (15) Life On Land, (16) Peace, Justice, and Strong Institutions, (17) Partnerships for the Goals. The higher overall score is, the more SDGs have been achieved. On the other hand, the Life Expectancy Index from HDI is an indicator of humans' long and healthy life.

Finally, we compare the human rights component of the JDII with HDI and Education Index from HDI. Education Index measures the dimension of mean years of schooling for adults aged 25 years and more and expected years of schooling for children of school entering age.

MODEL DESCRIPTION

This section expands on the modifications made to the model and the correlation and regression analysis that was carried out by the analyst team.

STANDARDIZING JEWELRY DEVELOPMENT IMPACT (JDI) INDEX

With improvement of the model in the previous years, new questions were devised to make the model better and/or old questions were revised for an improved model. Due to this change, there were differences in the old and new questionnaires. Standardizing the questionnaire to validate the data helps us avoid biases and/or unequal measurement of components.

On comparing the question sets that were used in previous years, we identified a difference of 7 questions that were used in the most recent report but were missing from the previous questionnaires. Most of the questions were yes or no type and scored on 0-5 scale. One new question was added under the Governance component of JDI Index, three new questions were added under the Environment component of JDI Index and two new questions were added under the Human Health component of JDI Index. The questions that were revised in the most recent questionnaire explored the same path as the old questions and therefore, we decided not to score those. Following are the list of questions that were added to the questionnaire to match the latest (2020) questionnaire for improved reliability of the analysis:

1. Governance: Is there existence of written or formal anti-corruption programs that prohibit bribery in business practices and transactions?

2. Environment: Is there enough recycling of raw materials in the product making process?
3. Environment: Are there initiatives to reduce electricity consumption of the burn-out process?
4. Environment: Are there initiatives to reduce electricity consumption in the mining process?
5. Environment: Are there initiatives to reduce fuel consumption of the mining and product manufacturing process?
6. Human Health: Are there initiatives regarding reduction of mercury?
7. Human Health: Are there initiatives regarding arsenic?

Following a similar methodology as the previous groups who had worked on the Jewelry Development Impact (JDI) Index, we conducted in-depth research for each of those questions in the respective countries in order to score them. Scoring was done using the knowledge that we gained through our research on the overall jewelry and mining industry and research on specific jewels that were analyzed in the prior years. The questions were scored on a 1-7-point Likert scale where 1 indicates constant risk or low to no probability of an incident taking place and 7 indicates little to no risk or high probability of an incident taking place. The scale can also be found in the 'Standardizing Questionnaire' section.

CORRELATION ANALYSIS RESULTS

Correlation Analysis was performed on the five components of Jewelry Development Impact (JDI) Index. For this analysis we focus on the correlation coefficient (R), coefficient of determination (R-squared), and the trendline for the JDII component with its individual comparable index.

For all the chosen comparable indices, we observe a positive correlation i.e. they all have a positive trendline and positive R-squared. The graphs for this analysis can be found in Annex C of the document. Following is the summary of each JDII component with its equivalent index:

JDII Component	Index(es) for comparison	R	R-squared
Governance	RGI	0.582	0.339
	WGI	0.802	0.644
	HDI	0.389	0.152
	GDP Per Capita	0.375	0.141
Economy	% of GDP from Mining	0.552	0.305
	GDP Per Capita	0.491	0.241
Environment	EPI	0.429	0.184
	HDI	0.459	0.211
Human Health	SDG	0.461	0.212
	HDI (Life expectancy index)	0.308	0.124
Human Rights	Education Index	0.052	0.323
	HDI	0.395	0.154

From the table above, the result shows that the Governance component of JDI Index versus WGI has a strong correlation ($R \geq 0.7$). It also shows that the Governance component of JDI Index versus RGI and Economy component versus GDP from mining have a moderate correlation ($0.5 \leq R < 0.7$) but the rest comparison turns out weak or no correlations ($R < 0.5$). Furthermore, we observe that R-squared aren't extremely high for any of the indices but there definitely is a positive correlation. Since we are working with real world data, there is a certain level of uncertainty as to what would be considered a good R squared as this varies for all studies and there seems to be a lot of speculation around the topic. Therefore, we carry out further analysis by combining these indices in our regression analysis in the next section.

REGRESSION ANALYSIS RESULTS

After running the correlation analysis, multiple regression analysis was performed on the five components of Jewelry Development Impact Index with the group of equivalent indices. We ran a combination of different multiple regression analyses. For the Governance Component of JDI Index, two separate regression analyses were run, since both those analyses sets gave us a statistically significant model and we wanted to provide an option to the future analysts between those. All other components of JDI Index have one regression analysis. Based on our findings, following are the division of those analyses: Resource Governance Index (RGI), World Governance Index (WGI), Human Development Index (HDI) and GDP Per Capita for the Governance component; Resource Governance Index (RGI) and World Governance Index (WGI) for the Governance component; percentage of GDP from mining and GDP Per Capita for the Economy component; Environmental Performance Index (EPI) and Human Development Index (HDI) for the Environment component; Human Development Index (HDI) and Education Index for the Human Right components; Sustainable Development Goals and Life Expectancy for the Health component. The data set used for this analysis can be found in Annex A of the document and the regression analysis output can be found in Annex D of the document.

Following is the summary for findings of each of the components with their indices:

Component of JDII	Index(es) for Comparison	R-squared	Significance F
Governance	RGI & WGI & HDI & GDP per capita	0.853	0.026
Governance	RGI & WGI	0.648	0.026
Economy	% GDP from mining & GDP per capita	0.538	0.067
Environment	EPI & HDI	0.211	0.437
Human Health	SDG & Life Expectancy Index from HDI	0.213	0.432
Human Rights	HDI & Education Index from HDI	0.514	0.080

EXPLANATION OF OUTPUT

Governance (Option 1): When we compared the JDII component with the four indices mentioned in the table, we got a R-squared of 0.853 which indicates that 85.3% of the Governance component can be explained by the four comparable indices which is really strong. In other words, the model explains 85.3% of the variability of the governance component around its mean. At 95% significance level, the significance F is 0.026 (<0.05) which proves that the model is statistically significant which indicates that with 95% confidence we can say that the governance component matches the goal and is measuring what it intends to. This will also help in predicting Governance scores for countries that haven't been evaluated yet.

Governance (Option 2): When we compared the JDII component with the two indices mentioned in the table, we got a R-squared of 0.648 which indicates that 64.8% of the Governance component can be explained by the two comparable indices which again is really strong. In other words, the model explains 64.8% of the variability of the governance component around its mean. At 95% significance level, the significance F is 0.026 (<0.05) which proves that the model is statistically significant which indicates that with 95% confidence we can say that the governance component matches the goal and is measuring what it intends to. This will also help in predicting Governance scores for countries that haven't been evaluated yet.

Even though both Governance (option 1) and Governance (option 2) are good model, our team prefers the option 1 (analysis with RGI & WGI & HDI & GDP per capita) since the model returns a greater r-squared of 0.853 and closer the r-squared is to 1, more variability is accounted for in the model. Ideally, we would want more variability accounted for and therefore, Governance (option 1) model is better as compared to Governance (option 2) model.

Economy: When we compared the JDII component with the two indices mentioned in the table above, we observe a R-squared of 0.538 which indicates that 53.8% of the Economy component can be explained by the two comparable indices. This is not as high as what we saw for the Governance component but since our comparison is using real world data, we assume that this is still a pretty decent representation of the model. In other words, the model explains 53.8% of the

variability of the governance component around its mean. At 95% significance level, the model was not statistically significant and therefore, we decided to change to significance level to 90%. At 90% significance level, the significance F is 0.067 (<0.1) which proves that the model is statistically significant which indicates that with 90% assurity we can say that the Economy component matches the goal and does indicate what the model intends to. This will also help future analysts in predicting Economy scores for countries that haven't been evaluated yet.

Environment: Comparing the JDII Environment component with the indices mentioned in the table above, we notice a R-squared of 0.211 which indicates that only 21.1% of the Environment component can be explained by the two equivalent indices. Significance F received from this analysis was also very poor. At 95% significance level, significance F is 0.437 and expanding the significance level for this segment will also not work. Future analyst team would need to explore additional indices, add more questions and/or revise existing questions.

Human Health: When we compared this JDII component with the two respective indices mentioned in the table above, we noticed a R-squared of 0.213 which indicates that only 21.3% of the Human Health component can be explained by the two equivalent indices. Significance F received from this analysis was also very poor. At 95% significance level, significance F is 0.432 and similar to the JDII Environment component, expanding the significance level for this segment will also not work. Again, similar to the Environment component of JDII, the Future analyst team would need to explore additional indices, add more questions and/or revise existing questions.

Human Rights: Comparing this JDII component with the respective indices mentioned above in the table, we observe a R-squared of 0.514 which indicates that 51.4% of the Human Rights component can be explained by the two comparable indices. In other words, the model explains 51.4% of the variability of the governance component around its mean. This is not as high as what we saw for the Governance component but similar to explanation for the Economy component, since our comparison is using real world data, we assume that this is still a pretty decent representation of the model. At 95% significance level, the model was not statistically significant and therefore, we decided to change to significance level to 90%. At 90% significance level, the significance F is 0.080 (<0.1) which proves that the model is statistically significant which

indicates that with 90% assurity we can say that the Human Right component matches the goal of the index and measures what it intends to. This will also help future analysts in predicting Human Right scores for countries that haven't been evaluated yet.

CONCLUSION

This report is the seventh analysis of the case studies and the first attempt to validate the JDI Index that explores the suitability of utilization of JDII as a single tool for analyzing the jewelry industries in different countries. In this report, question sets of the first eight country analyses (Peru, Botswana, Afghanistan, Myanmar, South Africa, Madagascar, Colombia and Zambia) were compared to that of Tanzania and Brazil which contain the latest questions and based on that comparison, questions were added to the old questionnaires and were scored. After normalizing the questionnaire, correlation analysis and regression analysis were carried out in order to suggest the validity of the JDII.

With the analysis that was carried out, we received positive results for three out of five components: governance, economy and human right components were found to be statistically significant whereas environment and human health components were found to be statistically insignificant. For governance component option-1 at 95% significance had r-squared of 0.853 and the significance F is 0.026 (<0.05) which proves that the model is statistically significant and option-2 at 95% significance, r-squared of 0.648 and the significance F is 0.026 (<0.05) which again proves that the model is statistically significant. For economy, at 90% significance, a r-squared of 0.538 and the significance F is 0.067 (<0.1) was observed which proves that the model is statistically significant. For human rights, at 90% significance level a r-squared of 0.514 and the significance F of 0.080 (<0.1) was observed which proves that the model is statistically significant.

Our hope with this analysis is that future researchers and analysts who will be working on further building the JDII, be able to verify their results using some additional real-world indicators and also perform predictive analysis to predict scores for components for where they might be dealing with missing data and/or for which the overall component score is unknown. Methodology

to run predictive analysis still needs to be explored as this paper doesn't discuss how to predict scores for components where the score is unknown but only explores the question of "can the score be predicted and with how much confidence can the scores be predicted?". Additionally, we strongly recommend use of large data sets for more accurate results for validation of JDII components. Overall, we do recommend the use of JDII as a comprehensive tool as it does explore each of the components in-depth even with such a complicated nature of the jewelry industry and the countries it investigates.

RECOMMENDATION

1. **Collect data on more countries to carry out predictive analysis in the future**

Analysis was done utilizing previous case studies for ten countries in which their JDII scores were calculated. However, the sample size of ten countries is still very small to conduct data analysis compared with the number of countries in the whole world. A bigger sample size would have increased the statistical power for our model. Due to the limitation of the study environment and COVID-19, collecting data is more difficult than before. In the future, we hope that more countries' JDII scores are able to be given based on the new questionnaire, and then check our model's accuracy and make a case for a stronger predictive model. Or, collecting more countries' data from the related indexes, such as RGI and WGI, run our model to do predictive analysis, which can output the JDII score of other countries.

2. **Consider differences in mining based on different products in different countries.**

Based on the previous JDII research for ten countries, different countries have different products for research objects in the mining industry. For example, the cases examined in the report involve the platinum industry in South Africa and the sapphire industry in Madagascar. In the case study of Colombia and Zambia, the emerald mining industry is involved. In order to increase robustness, our model does not consider the impact of different products in different countries. We assume the general products in the mining industry. In the future research, the model expectedly to be developed to have the ability to analyze the impact of different products in different countries.

3. **When doing further analysis, standardize the questionnaire again**

In case the decision is made to add new questions to the Jewelry Development Impact (JDI) Index, our suggestion is to score the other countries which don't include those questions. This will help in having a reliable data set which gives equal weight to all the countries instead of being a biased representation of the results. It is really important to have a uniform question set to achieve reliability.

4. Explore additional indices for comparison with the Environment and Human Rights component of JDI.

In the model, the JDII component of governance, economy, and human health with their own comparable indices are statistically significant, except the JDII component of environment, human rights. For further research, it is necessary to explore additional indices, add more questions and/or revise existing questions for the JDII component of environment and human rights in order to be satisfied with our model.

5. Questionnaire should be based on each country's environment, not the same for all.

In the previous JDII research for ten countries, questions for environment indicators are the same or almost the same for all of the countries. After researching and analyzing we think that questions related to environmental factors should not be the same for all of the countries, because each country has different climate change and different environmental laws. We recommend adding more related questions based on the environmental factor of each country or try to make more general questions on environment indicators.

ANNEX A: STANDARDIZATION QUESTIONNAIRE

Risk to Governance

Questions on Accountability Mechanisms

1. Is there presence of formal institutions to monitor the industry? If yes, how effective are the institutions?
2. Are violators of the rule of law in regard to the industry held accountable?

3. Are the locations of industry actors, such as mining companies, etc., physically accessible to the government?
4. Is there confidence that the government holds industry actors accountable?
5. Are there informal institutions that monitor the industry on a micro-level?

Questions on Transparency

1. Is data about industry actors easily accessible and publicly available?
2. Is the government a participant member of the Open Government Partnership?
3. Are there any civil society actors focused on industry issues present?
4. Is information about the issuing of prospecting and mining permits open and available to the public?
5. Does the government have a framework to ensure the traceability of the mined resources?
6. Are whistleblowers in the industry protected under the law?
7. Is the country an implementer of the Extractive Industries Transparency Initiative (EITI)?
8. Are any of the below OECD due diligence guidelines followed?

- Responsible Business Conduct (human rights, environment, corruption, and government)

- OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas.

Questions on Corruption Prevention

1. Are there specific anti-corruption laws for the industry?
2. Are anti-corruption laws enforced in relation to the industry?
3. Do government officials publicly disclose their finances?
4. Does rent-seeking have a presence in the industry?
5. Is there existence of written or formal anti-corruption programs that prohibit bribery in business practices and transactions?

Questions on Industry Regulation

1. Is there an active government body or structure that establishes industry regulations?
2. Does the government enforce industry regulations?
3. Are there penalties for violating industry regulations?
4. Are industry actors incentivized, either in terms of financial returns or threat of prosecution, to abide by industry regulations?

5. Is the process of obtaining permits or licenses related to the industry accessible?
6. Is the process of obtaining permits or licenses related to the industry timely?

Questions on Criminal Organizations/Non-State Actors

1. Is the illegal industry free of international criminal organizations?
2. Is the illegal industry free of terrorist organizations?
3. Is the illegal industry free of national or local criminal organizations?
4. Is the industry free of illegal or criminal government involvement?

Risks to Economy

Questions on Industry Employment

1. What is the availability of the formalized industries?
2. Is the potential income for most workers in the industry equal to or higher than the country average?
3. Do companies in the industry hire the majority (more than 60%) of their employees locally, i.e., employees are citizens of the country?
4. Does the work offered in this industry provide a reliable income?
5. Does the country's labor force have the capacity (education/skills) to take up other, service-sector jobs (i.e. marketing, oversight, etc.) - in addition to primary/extractive/mining activities?

Questions on Fiscal Sustainability

1. Does the government effectively collect taxes and royalties on the industry?
2. Does the government reinvest revenue earned from the industry back into communities most affected by the industry?
3. Has foreign direct investment in this industry generally been rising or stable in the last five years?
4. Has global demand for the precious mineral or gem generally been rising or stable in the last five years?
5. Is there enough of the natural resource left to ensure production for at least another decade?

Questions on Beneficiation

1. Does the industry in the country include any higher value adding activities, e.g., refinement, manufacturing, stone cutting, jewelry crafting, etc., other than mining?
2. Have there been any attempts by the government to create a national beneficiation strategy in this country?
3. Have there been any attempts by the business sector to create beneficiation in this country?
4. Is the country's labor force perceived as having the right skill sets and education levels necessary to pursue higher value adding activities than mining and refinement?

Questions on Smuggling and the Informal Economy

1. What percent of the total industry is formal? Formal means that industry companies operate as legally recognized as businesses
2. What is the availability of regulations in place to prevent illegal exports?
3. Does the government tend to actively prevent illegal exports and smuggling?
4. Is the precious mineral or gem easy for regulatory export agents to identify in its raw form?
5. Criminal Non-State Actor and Terrorist Funding
6. How organized is the informal industry?
7. Is the informal industry free of terrorist involvement?
8. Is the informal industry free of criminal organizations'?

Questions on Supply Chain – integrating specific supply chain questions into economy and governance scores

1. Do LSM companies ever work together to set industry standards in terms of ethical emerald extraction?
2. How significant is the illegal smuggling of commodities.?
3. What is the availability of local or international NGOs active in the country to ensure transparency and accountability in the supply chain process?
4. Do mining cooperatives have influence on the value chain?

Risk to Environment

Questions on Environmental regulatory stringency and enforcement

1. Does the process to receive a permit to prospect or mine include environmental concerns, including interference with the area's biodiversity, pollution, remediation, etc.?
2. Does the government have the capacity to enforce environmental protections?
3. Are there environmental reserves which are protected from ANY mining activity?
4. Are the protected areas free of mining-by-mining companies or informal industry actors? Is the government enforcing regulations to limit or remediate air pollution?
5. Is the government enforcing regulations to limit or remediate water pollution?
6. Is the government enforcing regulations to limit or remediate soil pollution?
7. Is there enough recycling of raw materials in the product making process?
8. Are there initiatives to reduce electricity consumption of the burn-out process?
9. Are there initiatives to reduce electricity consumption in the mining process?
10. Are there initiatives to reduce fuel consumption of the mining and product manufacturing process?

Questions on existence and extent of pollution

1. Are activities regarding mining or refining of the gem cause air pollution?
2. Does mining or refining of the gem cause water pollution?
3. Are there regulations in place to limit or remediate air pollution?
4. Are there regulations in place to limit or remediate water pollution?
5. Does mining or refining of the gem cause soil pollution?
6. Are there regulations in place to limit or remediate soil pollution?
7. How effective is the enforcement mechanism?

Questions on Risk to Biodiversity

1. Does mining of gems cause deforestation?
2. If mining causes deforestation, are reforestation initiatives in place?
3. To what extent does mining of gems contribute to the country's overall deforestation?
4. Does mining of precious gems cause erosion?
5. Does mining take place in areas designated as highly biodiverse?

Questions on post-production planning and remediation

1. Are there regulations to ensure environmental remediation after a mine closes
2. Does the government ensure and enforce remediation?

3. Is money set aside for remediation of closed mines appropriately distributed i.e., all the money collected for remediation from the mining company is used for remediation of the specified mine area?

Risk to Health

Questions on Human Health

1. Are safety measures taken by mining companies to provide protective equipment and training for miners?
2. If not, how widespread is the lack of safety measures in place for miners?
3. Is the government contributing to the healthcare facilities to combat diseases?
4. Are mining companies contributing to healthcare facilities to combat diseases?
5. Do mining activities cause bodily harm or fatality?
6. What is the availability of relevant health and safety act?
7. Are mining companies held accountable for the health and safety of their workers?
8. Do mine workers have health compensation provided by their employer?
9. What level of access do miners have to sanitation facilities?
10. Are there initiatives regarding reduction of mercury?
11. Are there initiatives regarding arsenic?

Questions on Food Security

1. Are arable lands, i.e., lands previously used to grow crops, now being used for mining?
2. After a mine is closed, is the community able to use the land for farming?
3. Are workers in the country's agricultural labor force leaving agriculture to work in the industry?
4. Has mining had an impact on the availability of food for the population?

Questions on Water Security

1. Is water security a problem for the country?
2. Has the mining industry had an impact on the availability of clean water?
3. Is the industry reusing, using, or purchasing gray water instead of using potable water for mining, refinement, and or manufacturing?

4. Do workers in the industry have access to clean drinking water in their workplace and in their respective living accommodations?
5. Does the industry require water for refinement and/or mining?

Risks to Human Rights

Questions on Workers' Rights

1. Is there a minimum working age in the industry?
2. Is there a limit of working hours in the industry?
3. Are workers unionized and/or have they organized strikes collectively?
4. Does the government provide compensation and resettlement package as prescribed in the law to individuals/families affected by mining?
5. Do workers have any access to social protections i.e. social insurance, assistance, safety nets?
6. Do the workers have legal protections from the government?

Questions on Indigenous/ethnic group rights

1. Is indigenous and/or ethnic groups' ability to maintain and practice their culture negatively affected and or inhibited by the presence or operations of the industry?
2. Are certain ethnic and/or indigenous groups excluded from participating in the industry?
3. Are indigenous and/or ethnic groups being displaced from their land by the industry?
4. Are indigenous and/or ethnic groups barred from employment in this industry, formally and informally?

Questions on Women's Rights

1. Are women able to participate in this industry equally to men?
2. Do women receive economic benefits from this industry equal to men, e.g.,in terms of wages or resettlement compensations?
3. Are women free from violence in association with the industry?
4. Are women able to profit from the industry independently of men?
5. Are women/girls sexually exploited in direct or indirect connection, e.g., concentrated presence of miners in mining towns, with the industry?

Questions on Children's Rights

1. Are children subject to forced labor in the industry?
2. Are children denied education because of this industry?
3. Are children's health or mental well-being threatened in some way because of this industry?
4. Does the government have laws to protect children's rights in general and or specific to the industry?
5. Are children's physical rights violated because of the industry? (including harmful practices based on tradition, culture, religion, or superstition)
6. Are children sexually exploited in direct or indirect connection to the industry?

Questions on Freedom from Violence

1. Has violence/conflict emerged as the result of the industry, e.g., from worker protests, illegal mining, etc.?
2. Has human trafficking increased as the result of this industry?
3. Has domestic violence increased as the result of this industry, e.g., as a result of male miner's behavior at home and with "hot money"?
4. Do communities in or around industry mining sites feel less secure?
5. Does the government actively intervene to prevent or mitigate violence resulting from the presence of the industry?

ANNEX B: DATA UTILIZED FOR EACH COMPONENT

Governance

Country	JDI Governance	RGI	WGI	HDI	GDP Per Capita
Tanzania	5.02	49.00	46.74	4.17	1122.10
Brazil	2.86	71.00	44.19	5.57	8717.20
Myanmar	2.39	27.00	18.35	4.50	1407.80
Afghanistan	2.75	34.00	8.50	3.98	502.10
Botswana	4.68	61.00	71.03	5.37	7961.30
Peru	4.02	62.00	48.40	5.55	6977.70
South Africa	4.73	57.00	57.99	5.23	6001.40
Madagascar	2.62	36.00	23.64	4.13	522.20
Colombia	4.66	69.00	46.59	5.57	6432.40
Zambia	3.80	50.00	33.81	4.55	1291.30

Economy

Countries	JDI Economy	Mining Sector Percentage of GDP	GDP Per Capita
Tanzania	4.33	15%	1,122.10
Brazil	3.8	2.50%	8,717.20
Madagascar	4.29	7%	522.2
South Africa	3.91	9%	6,001.40
Peru	4.43	10%	6,977.70
Columbia	4.26	2.40%	6,432.40
Zambia	3.72	14.62%	1,291.30
Afghanistan	3.15	13%	502.1
Myanmar	3.57	13.80%	1,407.80
Botswana	5.41	35%	7,961.30

Environment

Country	JDI Environment	EPI	HDI
Tanzania	2.6875	31.1	0.528
Brazil	3.7775	51.2	0.761
Myanmar	2.345	25.1	0.584
Afghanistan	2.8725	25.5	0.496
Botswana	4.78	40.4	0.728
Peru	2.6325	44	0.759
South Africa	3.049	43.1	0.705
Madagascar	3.199	26.5	0.521
Columbia	3.2775	52.9	0.761
Zambia	2.7275	34.7	0.591

Human Right

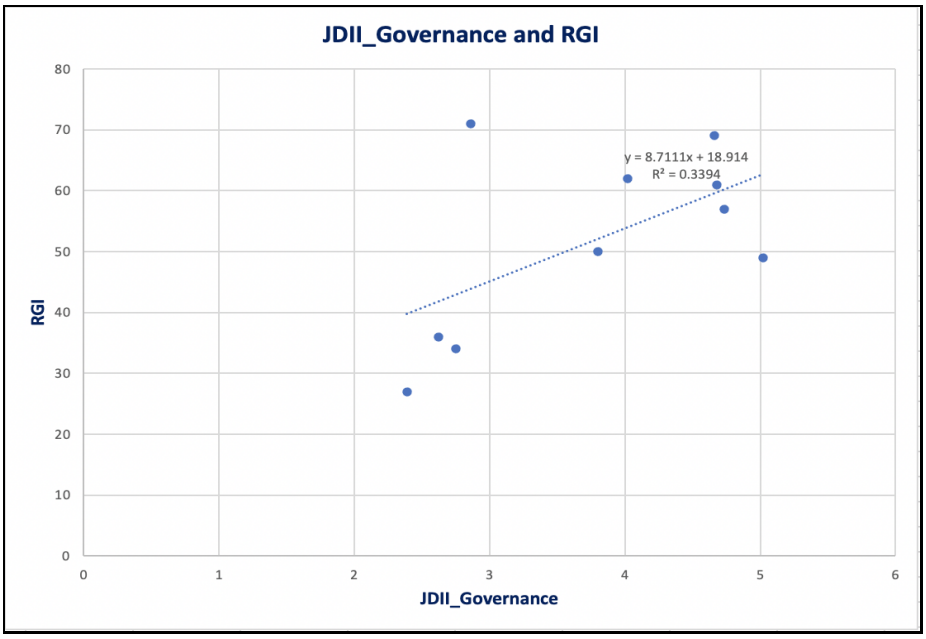
Country	JDI Human Right	HDI	Education index
Tanzania	3.284	4.17	3.54
Brazil	2.866	5.57	5.13
Myanmar	2.8925	4.5	3.71
Afghanistan	2.44	3.98	3.48
Botswana	4.708	5.37	4.98
Peru	3.044	5.55	5.15
South Africa	5.884	5.23	5.33
Madagascar	3.568	4.13	3.96
Columbia	4.024	5.57	5.1
Zambia	3.424	4.55	4.43

Human Health

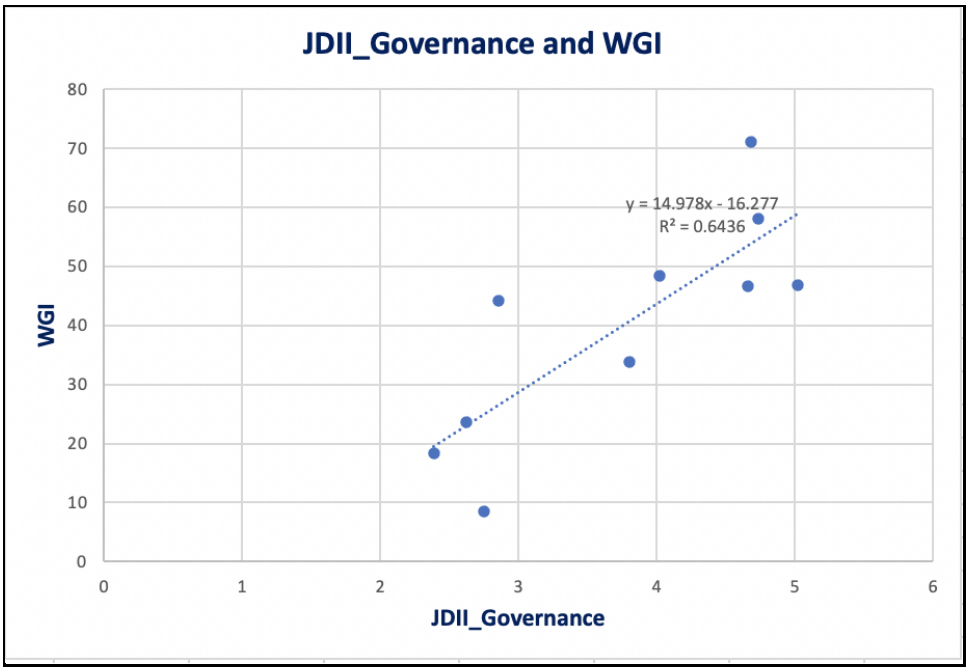
Country	JDI Health	SDG	Life expectancy index
Tanzania	3.31	56.6	5.16
Brazil	3.95	72.7	6.14
Myanmar	2.88	64.6	5.33
Afghanistan	2.75	54.2	5.1
Botswana	4.58	61.5	5.55
Peru	3.18	71.8	6.21
South Africa	3.60	63.4	5.05
Madagascar	2.80	49.1	5.31
Columbia	3.36	70.9	6.27
Zambia	2.74	52.7	5.01

ANNEX C: CORRELATION GRAPHS

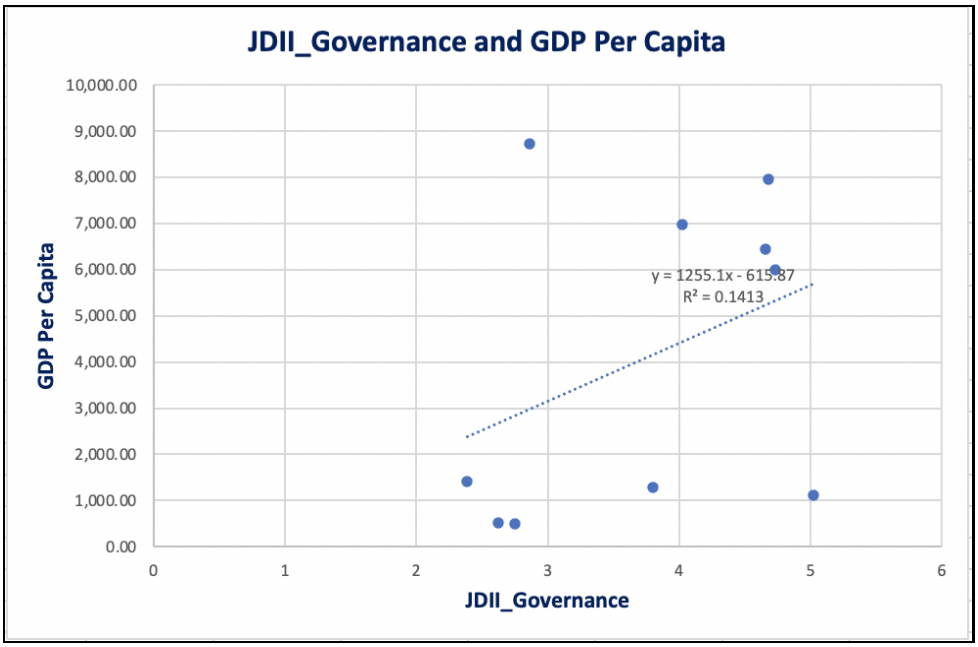
Governance with RGI



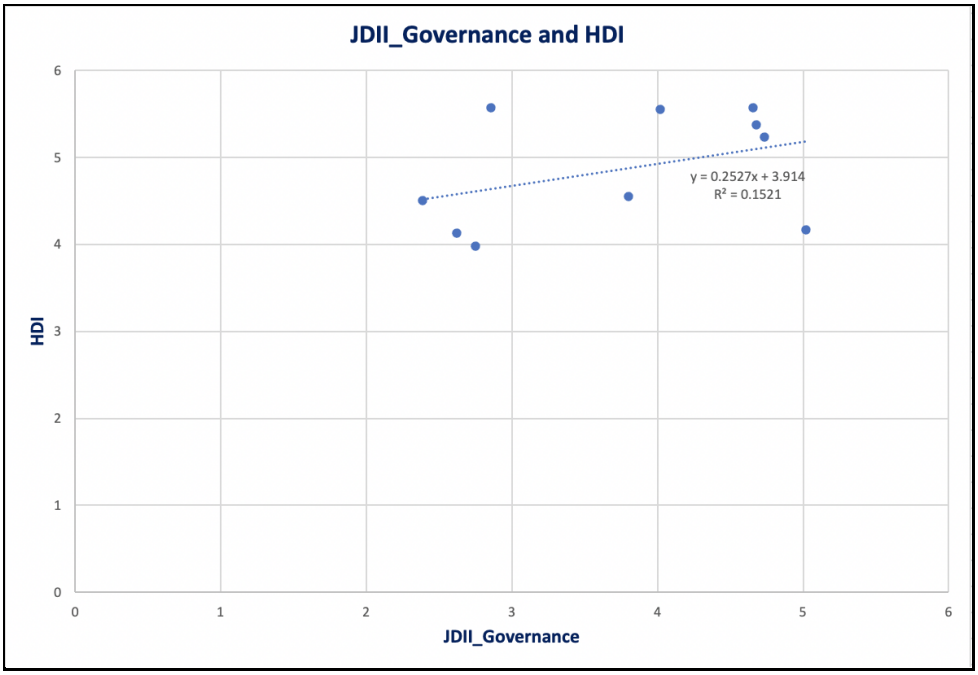
Governance with WGI



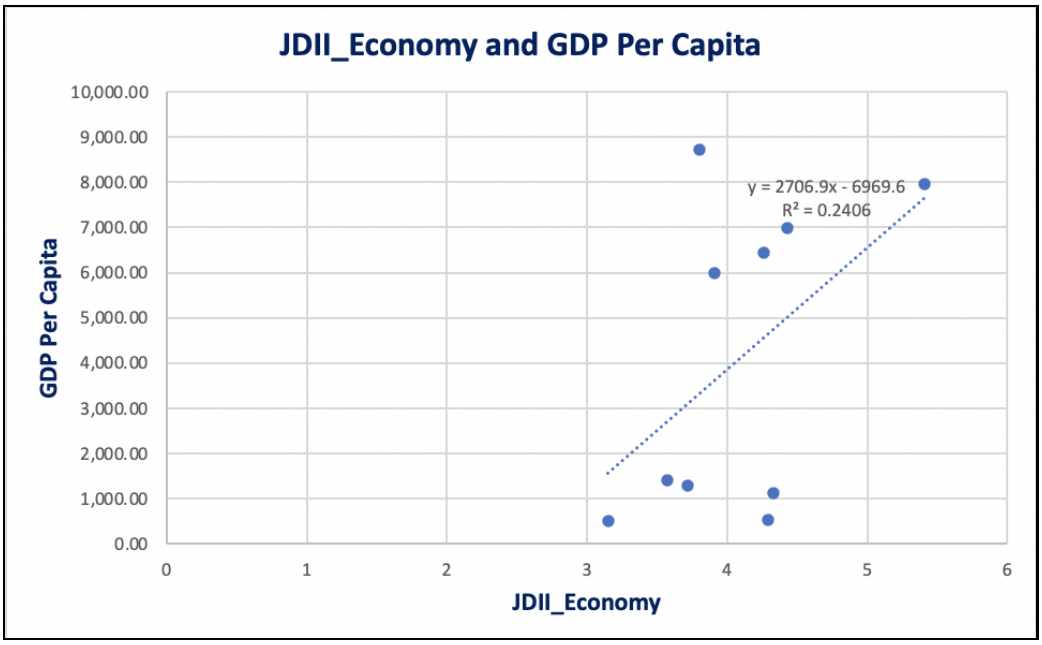
Governance with GDP Per Capita



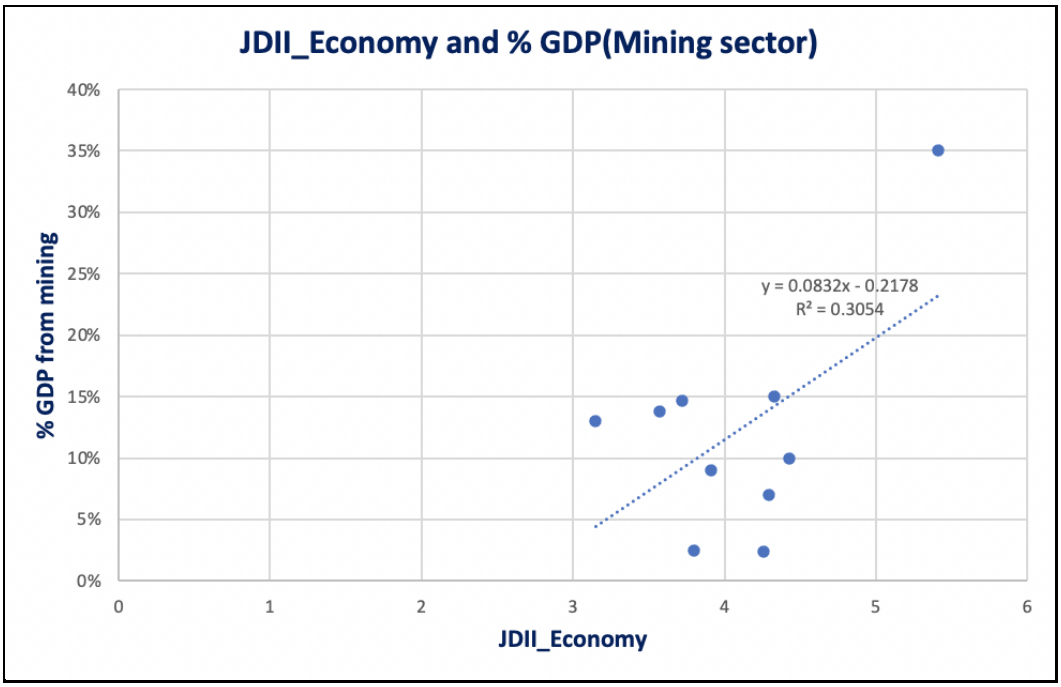
Governance with HDI



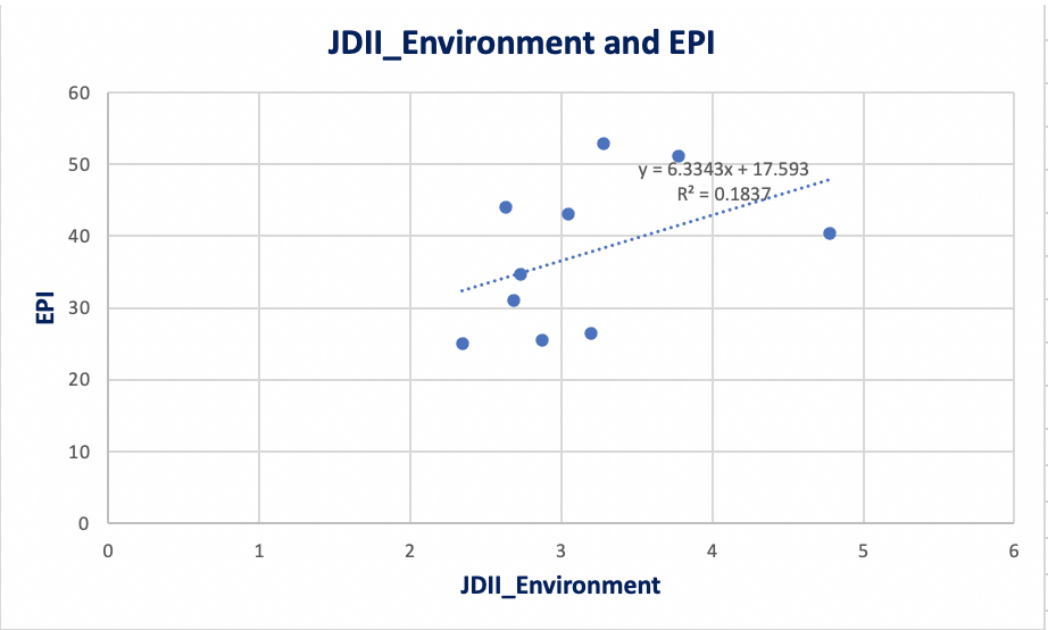
Economy with GDP Per Capita



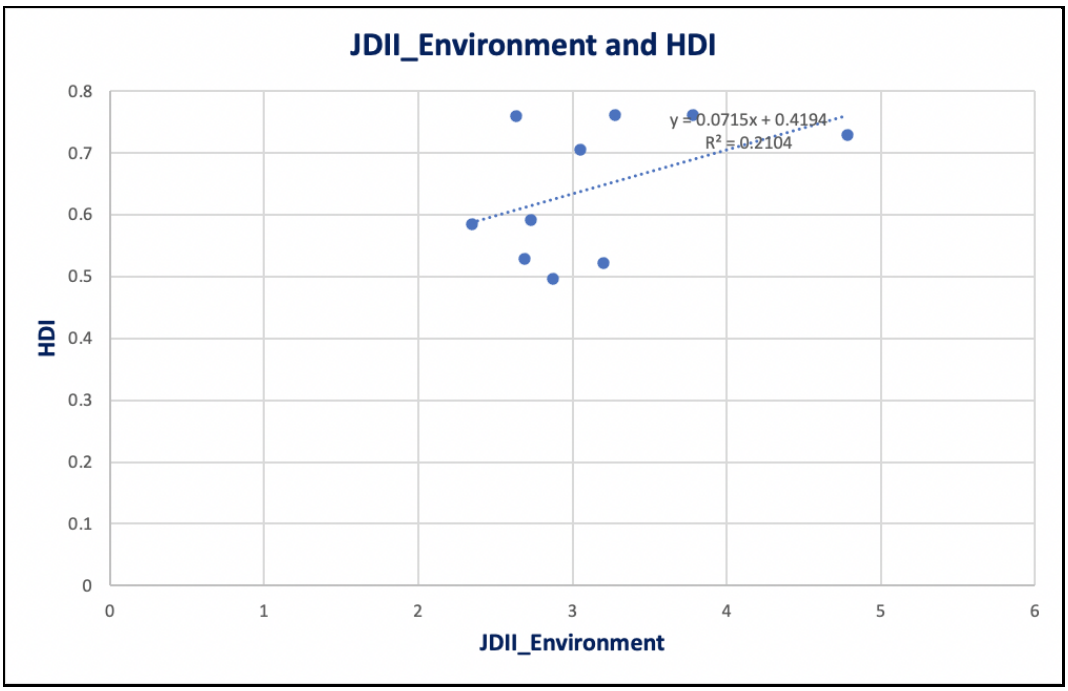
Economy with % GDP from Mining



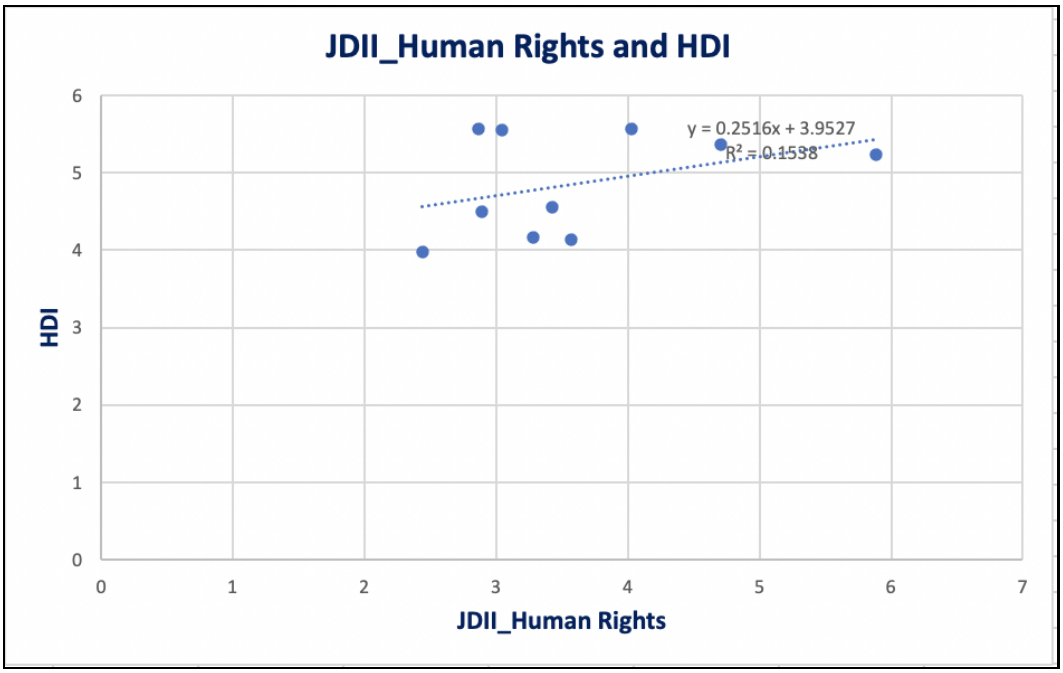
Environment with EPI



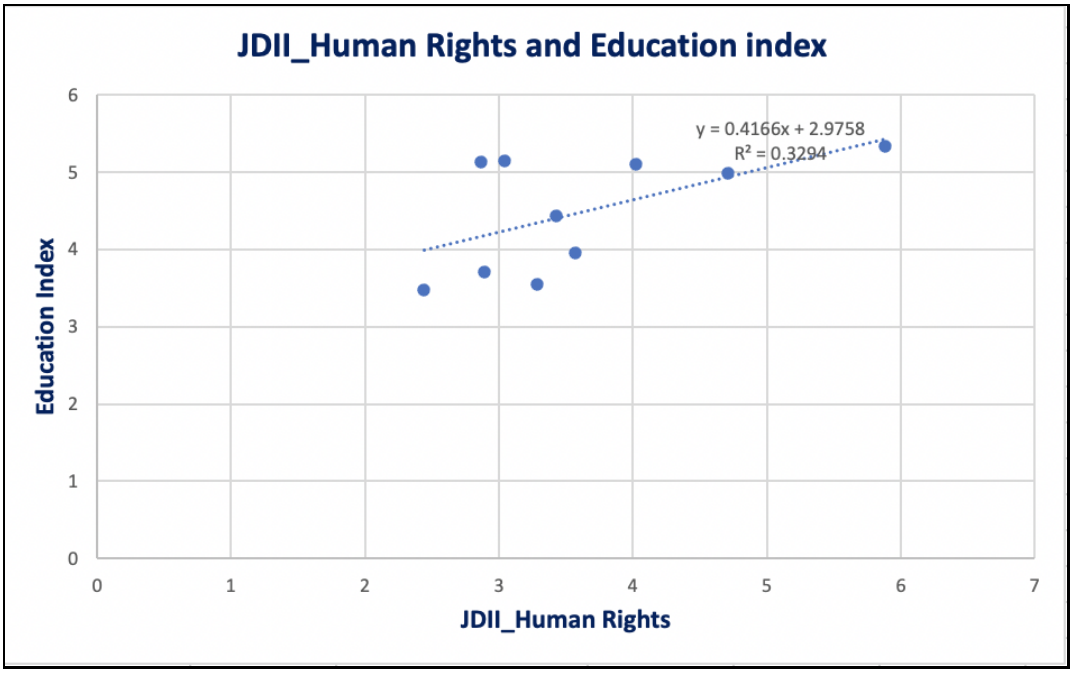
Environment with HDI



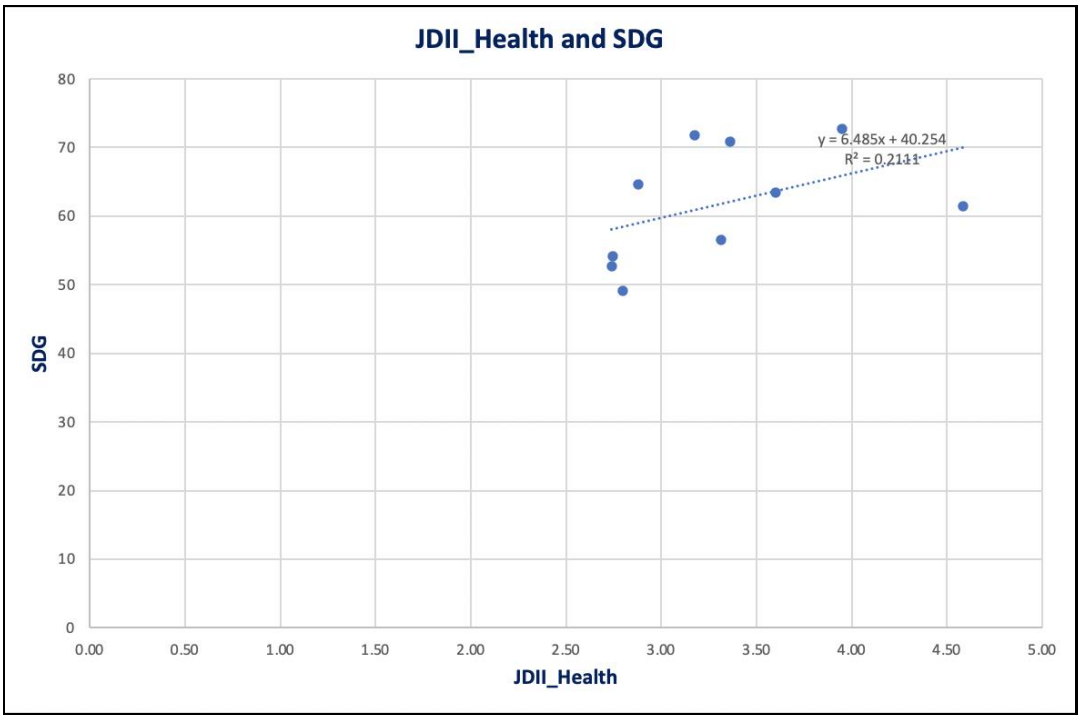
Human Right with HDI



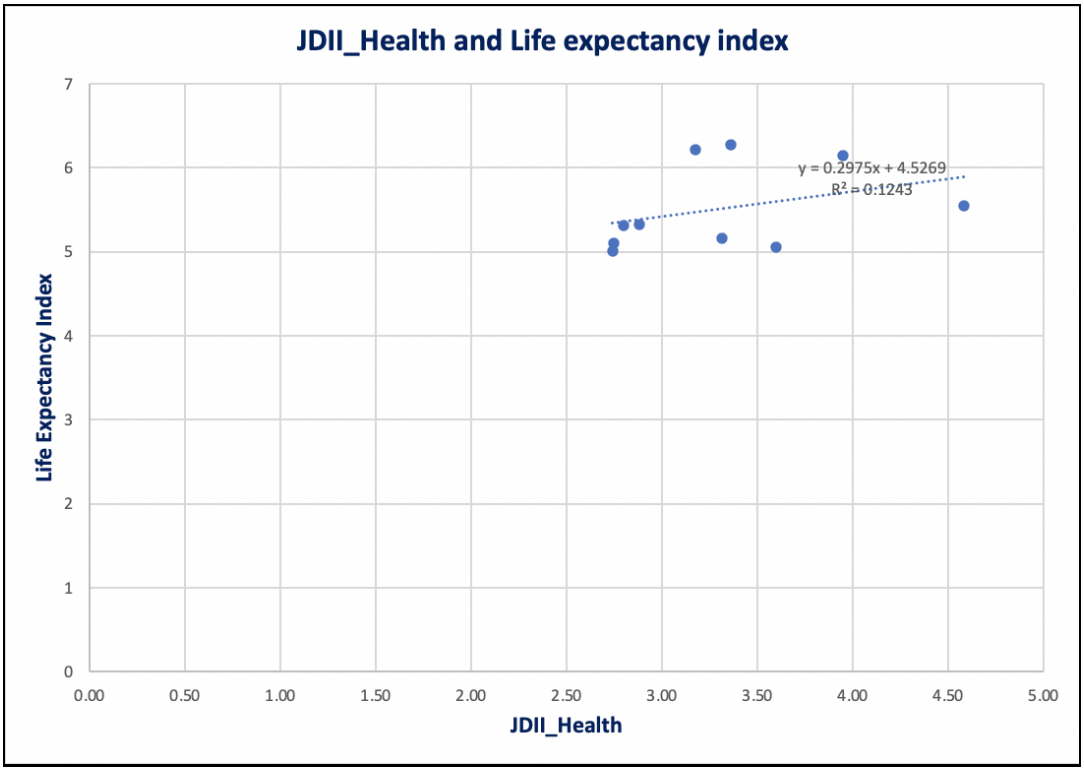
Human Right with Education Index



Human Health with SDG



Human Health with Life Expectancy Index (from HDI)



ANNEX D: REGESSION ANALYSIS

Governance (Option 1)

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.92383133							
R Square	0.85346432							
Adjusted R Square	0.73623577							
Standard Error	0.52118373							
Observations	10							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	4	7.910313219	1.9775783	7.28034561	0.0257579			
Residual	5	1.358162381	0.27163248					
Total	9	9.2684756						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-1.5364504	3.980360249	-0.3860079	0.71536944	-11.76829214	8.69539137	-11.768292	8.69539137
RGI	0.0343987	0.026060873	1.31993677	0.24405466	-0.032592902	0.10139031	-0.0325929	0.10139031
WGI	0.05931592	0.015323607	3.87088528	0.01174973	0.019925339	0.09870651	0.01992534	0.09870651
HDI	0.55398312	0.99410109	0.55727041	0.60136729	-2.001435081	3.10940133	-2.0014351	3.10940133
GDP Per Capita	-0.0003781	0.000201245	-1.8789237	0.11904113	-0.00089544	0.00013919	-0.0008954	0.00013919

Governance (Option 2)

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.804721719							
R Square	0.647577046							
Adjusted R Square	0.546884773							
Standard Error	0.68310463							
Observations	10							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	2	6.002052047	3.00102602	6.43124868	0.025985116			
Residual	7	3.266423553	0.46663194					
Total	9	9.2684756						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.214941937	0.826275126	2.6806349	0.03151026	0.261111736	4.16877214	0.26111174	4.16877214
RGI	-0.006653812	0.023770402	-0.2799201	0.78762998	-0.062861881	0.04955426	-0.0628619	0.04955426
WGI	0.047105351	0.019038693	2.47419042	0.04257083	0.002085997	0.09212471	0.002086	0.09212471

Economy

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.73342319							
R Square	0.53790958							
Adjusted R Square	0.40588374							
Standard Error	0.47318419							
Observations	10							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	2	1.824487087	0.91224354	4.07427515	0.06707248			
Residual	7	1.567322913	0.22390327					
Total	9	3.39181						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	3.28629458	0.317941224	10.3361701	1.7197E-05	2.53448305	4.03810611	2.53448305	4.03810611
GDP(Mining sector)	3.62196494	1.706567505	2.12236839	0.07147111	-0.41342597	7.65735584	-0.413426	7.65735584
GDP Per Capita	8.7373E-05	4.65585E-05	1.87663181	0.10267272	-2.272E-05	0.00019747	-2.272E-05	0.00019747

Environment

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.4588869							
R Square	0.21057719							
Adjusted R Square	-0.0149722							
Standard Error	0.70940247							
Observations	10							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	2	0.939691032	0.46984552	0.93361902	0.437103067			
Residual	7	3.522763068	0.50325187					
Total	9	4.4624541						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1.27850173	1.807332649	0.70739702	0.50218445	-2.995160886	5.55216434	-2.9951609	5.55216434
EPI	0.00202872	0.059802575	0.03392359	0.97388514	-0.1393819	0.14343934	-0.1393819	0.14343934
HDI	2.76705436	5.673182314	0.48774289	0.64063652	-10.64789013	16.1819988	-10.64789	16.1819988

Human Right

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.7166748							
R Square	0.51362277							
Adjusted R Square	0.37465784							
Standard Error	0.81023675							
Observations	10							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	2	4.852806114	2.42640306	3.6960605	0.080242848			
Residual	7	4.595385111	0.65648359					
Total	9	9.448191225						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.29711294	2.140937513	1.07294721	0.31888457	-2.765399829	7.3596257	-2.7653998	7.3596257
HDI	-1.9529847	1.199307311	-1.6284272	0.14745844	-4.788895833	0.88292647	-4.7888958	0.88292647
Education index	2.41279817	1.060257745	2.27567134	0.05699886	-0.09431301	4.91990934	-0.094313	4.91990934

Human Health

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.46175629							
R Square	0.21321887							
Adjusted R Square	-0.0115757							
Standard Error	0.60142332							
Observations	10							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	2	0.6861677	0.34308385	0.94850527	0.432005001			
Residual	7	2.531970078	0.36171001					
Total	9	3.218137778						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1.53956357	2.278046962	0.67582609	0.5208455	-3.847161522	6.92628866	-3.8471615	6.92628866
SDG	0.03724568	0.041883534	0.88926781	0.40338273	-0.061793141	0.1362845	-0.0617931	0.1362845
Life expectancy index	-0.0951964	0.700634747	-0.1358716	0.89574763	-1.751934272	1.56154156	-1.7519343	1.56154156

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