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Exploring the association between economic growth and provety

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**Revised table of independent variables:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name** | **Scale** | **Type** | **Example** | **Control variable** |
| **GDP growth (annual %)** | **ratio** | **numeric** | **3.33842794733555** | **N** |
| **Foreign direct investment, net outflows (% of GDP)** | **ratio** | **numeric** | **0.182397393890958** | **N** |
| **Exports of goods and services (% of GDP)** | **ratio** | **numeric** | **35.9034235358326** | **N** |
| **Imports of goods and services (% of GDP)** | **ratio** | **numeric** | **47.572713** | **N** |
| **Tax Revenue (% of GDP)** | **ratio** | **numeric** | **17.48323356** | **N** |
| **Land area (sq. km)** | **Nominal** | **numeric** | **743390** | **Y** |
| **Life expectancy at birth, total (years)** | **Nominal** | **numeric** | **82.190243902439** | **Y** |
| **Government expenditure on education, total (% of GDP)** | **ratio** | **numeric** | **4.7664098739624** | **Y** |
| **Population, total** | **Nominal** | **numeric** | **32889025** | **Y** |
| **Region** | **Nominal** | **String** | **Asia** | **Y** |

**Revised table of dependent variables:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Scale** | **Type** | **Example** |
| **Poverty headcount ratio at $2.15 a day (2017 PPP) (% of population)** | **ratio** | **Numeric** | **54.5** |
| **Gross domestic savings (% of GDP)** | **ratio** | **Numeric** | **11.188304** |
| **GNI per capita, PPP (current international $)** | **Nominal** | **Numeric** | **10450.0** |
| **Unemployment, total (% of total labor force) (modeled ILO estimate)** | **ratio** | **Numeric** | **18.28** |

**Data Description:**

* **Size**: Country(92) \* Time span in Years(10) \* Variables ct (14) = 12880
* **Type**: Numeric
* **Scale**: Ratio, Nominal
* **years**: 10
* **Period**:2007-2016
* **Data source**:The World Bank. (n.d.). World Bank Open Data. Retrieved from https://data.worldbank.org/

**Visual Analytics Matrix Table:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| # | Hypothesis | Research Question | Analytics Type | Variables | CHART | Conclusion |
| 1 | There is a negative correlation between GDP growth and Poverty rate. | Is there a negative correlation between GDP growth and Poverty rate. | Predictive | Independent Variables:  GDP growth rate  Dependent Variables:  Poverty ratio  Control Variables:  Life Expectancy | Scatter plot with trend line | Countries with higher GDP growth rates tend to have lower poverty rate |
| 2 | There is a negative correlation between foreign direct investment (FDI) and Poverty rate. | Is there a negative correlation between foreign direct investment (FDI) and Poverty rate. | Descriptive | Independent Variables:  Foreign Direct Investment  Dependent Variables:  Poverty ratio | Bubble chart | Countries with higher FDI outflows tend to have lower poverty rate |
| 3 | There is a negative correlation between imports and unemployment rate. | Is there a negative correlation between imports and unemployment rate. | Predictive | Independent Variable: Imports (% of GDP)  Dependent  Variable: Unemployment Rate (% of total labor force). | Dual-axis line chart | There seems to be an inverse relationship between the average imports and the average unemployment rate; |
| 4 | There is a positive correlation between exports and average income per person. | Is there a positive correlation between exports and average income per person. | Descriptive | Independent Variable:  Dependent Variable:  Control Variable: Geographic size, | Heat Map | Countries with high Exports tend to have higher GNI per capita |
| 5 | There is positive correlation between tax revenue and unemployment rate. | Is there a positive correlation between tax revenue and unemployment rate. | Descriptive | Independent Variable: Exports of good and services  Dependent Variable:  Unemployment rate  Control Variable:  Region | Bar Chart | Regions with high tax revenue tends to have higher unemployment rate. |

**Chart 1: Scatter plot: Impact of GDP growth on Poverty Rate (Fan Yang)**

A graph with blue dots

Description automatically generated

Figure 1. Impact of GDP growth on Poverty Headcount Ratio: A Scatter Analysis

* A Scatter plot that visualized the relationship between GDP growth and Poverty headcount ratio with life expectancy represented through the color intensity.
* Countries with higher GDP growth rates tend to have lower poverty headcounts, while also illustrating that countries with higher life expectancy tends to have lower poverty headcount ratio.
* With a p value < 0.0001, The graph reveals that there’s a strong indication that the null hypothesis can be rejected.

**Chart 2:Bubble chart: Impact of Foreign Investment on Poverty Rate (Fan Yang)**

A diagram of blue circles with white text

Description automatically generated

Figure 2. Impact of FDI outflow on Poverty headcount Ratio: A Bubble chart Analysis

* A bubble chart that visualized the relationship between FDI outflow and Poverty headcount ratio.
* The chart indicates that countries with darker shades, which represent a higher FDI outflow, tend to have smaller bubble suggesting a lower poverty rate.
* Encourage FDI outflows for poverty reduction: providing incentives for foreign businesses such as tax breaks or subsides.

**Chart 3:**

**Line Chart: Impact of Imports on Unemployment Rate (Fan Yang)**

A graph with blue and orange lines

Description automatically generated

Figure 3. Impact of Imports on Unemployment Rate: A line Chart Analysis

* A line chart compares the trends of average imports and average unemployment rate from 2006 to 2017.
* The chart shows that over the years, there seems to be an inverse relationship between the average imports and the average unemployment rate; generally, as imports increase, the unemployment rate decreases, and vice versa.
* Promoting imports might be an effective strategy for unemployment reduction.

**Chart 4: Heatmap: Impact of Exports on Income Measure(Fan Yang)**

A screenshot of a computer screen

Description automatically generated

Figure 4. Impact of Imports on average income per person: A heatmap Analysis

* A heatmap that visualized the relationship between Exports and Gross National Income
* The chart indicates that countries with darker shades, which represent a higher percentage of Exports, tend to have bigger size of square suggesting a higher Gross National Income.
* Enhancing Exports sectors for income improvement: strategies such as diversify trade policies, fostering better trade relations.

**Chart 5: Bar chart: Impact of Tax Revenue on Unemployment rate**

**A graph of different colored bars

Description automatically generated with medium confidence**

Figure 5.Impact of Tax Revenue on Unemployment Rate

* A bar chart that visualized the relationship between tax revenue and unemployment rates across different regions
* The chart shows regions with lower tax revenues generally tends to have lower unemployment rate, while Oceania as an exception
* Consider adjusting tax policies to enhancing employment rate such as lowering tax burdens.

**Statistical Model:**

**Hypothesis**: Economic growth indicators have the ability to predict poverty headcount ratio.

**Regression:**



**Interpretation**:

**P-value:** Values below 0.05 suggest that the coefficient is statistically significant.

* **Exports:** The coefficient (-0.3489) is significant (p-value: 0.0197), indicating that an increase in exports is associated with a decrease in the poverty headcount.
* **Tax revenue:** The coefficient (-0.1292) is significant (p-value: 0.0027), indicating that higher tax revenue is associated with a lower poverty headcount.
* **FDI outflow:** The coefficient (0.0079) is not significant (p-value: 0.8921), indicating no clear association between FDI outflow and poverty headcount.
* **GDP growth:** The coefficient (0.1233) is significant (p-value: 0.0024), indicating that an increase in GDP growth is associated with an increase in the poverty headcount, which could indicate that the growth is not inclusive or that other factors are at play.
* **GDS:** The coefficient (0.0062) is not significant (p-value: 0.9233), indicating no significant association between GDS and the poverty headcount.
* **Imports:** The coefficient (0.2089) is not statistically significant (p-value: 0.0834), but it is on the borderline.

**Model Evaluation**

The model explains a small but significant portion of the variance in the poverty headcount (Adjusted R² is about 10%). Some variables like Exports, Tax revenue, and GDP growth are significant predictors, while others like FDI outflow, GDS, and Imports are not significant at the 5% level. This could be an indication that while some economic growth indicators are associated with changes in poverty.

**Machine learning Model: Neural Network vs. Linear Regression**

**Predictors:**

* "GDP growth"
* "Foreign direct investment, net outflows (% of GDP)",
* "Exports of goods and services (% of GDP)",
* "Tax revenue (% of GDP)",
* "Imports of goods and services (% of GDP)",
* "Adjusted savings: net national savings (current US$)",
* "Land area (sq. km)"
* "Life expectancy at birth, total (years)",
* "Government expenditure on education, total (% of GDP)",
* "Population, total"

**Target:** “Unemployment, Total”

**Hypothesis**: Economic growth indicators and control variables together are able to somehow predict unemployment rate.

**Parameters:**

* # of neurons each layer: 100
* Learning rate: 0.001
* Max number of interactions: 200
* Alpha: 0.0001

**Results:**

**Linear Regression**

* **MSE:** 0.0297
* **R-squared:** 0.1113

**Neural Network**

* **MSE:** 0.0212
* **R-squared:** 0.3673

**Interpretation:**

The neural network model had a lower MSE of 0.0212 and an higher R² of 0.3673 than Linear Regression model, which indicates that the neural network model performed better than linear regression model on this dataset. Having a lower MSE and higher R-squared value meaning it explained a greater portion of the variance in the unemployment rate

**Conclusions:**

* Economic growth appears to have a positive impact on poverty reduction, influenced by factors such as life expectancy and geographic size.
* Increasing GDP growth and FDI outflow appears to support poverty rate reduction.
* Imports of goods and services and tax revenue may have impact on job creation, but the benefits may not be evenly distributed across different regions.
* Countries with higher exports appears to have higher average income per person.

**Implementation:**

* Strengthen efforts to increase GDP growth through innovation, infrastructure development as there are expected correlation with poverty reduction
* Encourage FDI outflows for poverty reduction: providing incentives for foreign businesses such as tax breaks or subsides.
* Promoting imports might be an effective strategy for unemployment reduction.
* Enhancing Exports sectors for income improvement: strategies such as diversify trade policies, fostering better trade relations.
* Consider adjusting tax policies to enhancing employment rate such as lowering tax burdens.

**Scope and limitations:**

* **Scope:**
  + This project investigates direct relationships between economic growth indicators GDP growth, FDI, exports, imports, Tax revenue and their corresponding influence on poverty measures.
  + This project develops visualizations using Tableau, offering findings and insights, aiming to educate and inform policymaking.
* **Limitations:** 
  + Data availability
    - unmeasured data from world bank.

**Future research**

* **Subgroup Analysis:**

Exploring how the relationship between economic growth and poverty is influenced by social factors, such as gender, culture, and age distribution, to address inequality.

* **More variables**:

Including additional variables such as technological innovation, natural resources environmental factors, and political stability to create a more research

**References:**

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