A Macroeconomic Approach for Modeling Road Traffic Fatality Rates

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Introduction

After spending a month in Senegal, I noticed the lack of sound infrastructure and safe, reliable transportation systems. Using World Bank data I developed a macroeconomic predictive model for national road traffic mortality rates.

Senegal, June 2018. Photo by Josephine Unger.

Data

Data taken from the World Bank tables, *World Development Indicators*, for 120 countries.

Dependent variable:

- Mortality Caused by Road Traffic Injury per 100,000 people (2015)

Independent Variables:

- Productivity: Purchasing Power Parity Gross National Income per Capita in $10,000 units (2015)
- Savings: Adjusted Net Savings as a Percent of GNI (2017)
- Infrastructure: Access to Electricity Percent of Population (2016)
- Health: Under-Five Mortality Rate Total per 1,000 Live Births (2017)

Correlation Matrix

	Road-Death	*Infra-Elec*	*Productivity*	*Savings*	*Infant Mortality*
Road-Death	1				
Infra-Elec	-0.745	1			
Productivity	-0.580	0.496	1		
Savings	-0.488	0.506	0.381	1	
Infant Mortality	0.711	-0.840	-0.571	-0.441	1

The Correlation Matrix suggests a strong relationship between access to electricity and road traffic deaths. However, it also demonstrates the potential for multi-collinearity.

Descriptive Statistics

	Road-Death	*Infra-Elec*	*Productivity*	*Savings*	*Infant Mortality*
Mean	17.5	81.639	1.971	6.716	27.792
Standard Deviation	9.243	28.151	2.170	13.755	27.469
Range	42	92.4	12.735	73.4	109
Minimum	3	7.6	0.071	-39.3	2
Maximum	45	100	12.806	34.1	111
Sum	2100	9796.7	236.548	805.9	3335
Count	120	120	120	120	120

Denmark, Israel, Norway, Sweden, and the United Kingdom had the least amount of road traffic deaths with a recorded 3 deaths per 100,000 people. All five countries had 100% population access to electricity.

Comparatively, Zimbabwe had the highest number of road traffic deaths with a recorded 45 deaths per 100,000 people. 38% of the population had access to electricity, ranking Zimbabwe 104th lowest in electricity access of the 120 countries used.

Regression Results

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.793
R Square	0.628
Adjusted R Square	0.615
Standard Error	5.732
Observations	120

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	6387.136	1596.784	48.594	0.000
Residual	115	3778.864	32.860		
Total	119	10166			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	30.104	3.843	7.834	0.000	22.493	37.715
Infra-Elec	-0.144	0.036	-4.033	0.000	-0.215	-0.073
Productivity	-0.964	0.300	-3.220	0.002	-1.558	-0.371
Savings	-0.071	0.045	-1.582	0.116	-0.160	0.018
Infant Mortality	0.056	0.037	1.500	0.136	-0.018	0.130

Statistical Significance

Infrastructure-Electricity and **Productivity** are both statistically significant at the 99% confidence level. We are 99% confident that Access to Electricity and Productivity help to predict Road Traffic deaths as modeled.

On average increasing access to electricity by 1% is estimated to decrease Road Deaths by 0.144 deaths per 100,000 holding other included factors constant.

Partial R Squared Results

Partial R-Squared demonstrates the additional variation in road traffic deaths that is explained by the variable of interest.

Adjusted R-Squared
0.615

Removed Variable of Interest		Removed Variable of Interest	
Productivity		Savings	
Adjusted R-Squared	Partial $R^2_{1.Else}$	Adjusted R-Squared	Partial $R^2_{2.Else}$
0.584	0.083	0.610	0.021

Removed Variable of Interest		Removed Variable of Interest	
Infant Mortality		Infra-Elec	
Adjusted R-Squared	Partial $R^2_{4.Else}$	Adjusted R-Squared	Partial $R^2_{3.Else}$
0.611	0.019	0.565	0.124

To find Partial R Square, the variable of interest is removed. The strength of the model using only the other variables is then used to gauge the contribution of the variable of interest.

The new Adjusted R-Squared demonstrates the percent of variation in road traffic deaths that is explained by the model without the removed variable of interest.

Infrastructure-Electricity has the highest impact on the model, explaining 12.4% of the variation in road traffic deaths that was unexplained using the other variables.

Conclusion

My model explains 61.5% of the variation in road traffic deaths.
Access to Electricity and Productivity proved to be the most statistically significant independent variables. Access to Electricity made the largest individual contribution to the strength of the model.

However, the strong similarity between the dependent variables caused multi-collinearity issues. All four of the independent variables in the model should separately contribute to understanding Road Deaths. This important topic merits further research into the relationship between a country's road traffic mortalities and economic development.