



Correlation Between Unemployment Rates and Socioeconomic Factors in the Municipalities of Puerto Rico

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Abstract

This study examines how municipal unemployment relates to poverty, education, and broadband across Puerto Rico's 78 municipalities, 2019–2024. A custom .NET pipeline builds a 468-observation panel from BLS LAUS and Census ACS data, which is analyzed using correlation and OLS regression. Poverty is the dominant correlate of unemployment in every year and across the pooled years. Education correlates bivariately but loses significance under collinearity with poverty. Broadband strengthens over the window. Findings support geographically targeted policy in the municipalities with the highest unemployment rates.

Introduction

Unemployment narrows social participation and deepens poverty over time. Puerto Rico has been in economic contraction since 2006 — the Section 936 phase-out, debt crisis, PROMESA, hurricanes, earthquakes, and COVID-19 have all strained its labor markets. About 40% of residents live below the poverty line. Territory-level numbers hide a great deal: the real story plays out municipality by municipality.

Background

Three factors are well-documented correlates of labor-market outcomes. Education improves re-employment [2]. Poverty and unemployment reinforce each other; unemployment shocks raise poverty in the long run [1]. Broadband access raises county-level employment [3] and reduces poverty most in less-developed regions [6]. Sub-national analyses reveal disparities that aggregate statistics conceal, and panel data accounts for fixed municipal characteristics over time [3]. What is missing is a study pulling these threads together for Puerto Rico, where inter-municipal variation is substantial.

Problem

Little empirical work examines municipal unemployment jointly with education, poverty, and broadband in Puerto Rico using panel methods. Objectives: identify which structural factors most closely track municipal unemployment, test whether the pattern holds through shocks, and inform geographically targeted policy — via a fully reproducible analytical pipeline.

Methodology

Design. A combined cross-sectional and longitudinal municipality-year panel: each of Puerto Rico's 78 municipalities observed annually, 2019–2024 (468 socioeconomic-indicator observations; 5,460 monthly unemployment observations). Observational — results are associations, not causal effects.

Data sources. Unemployment from BLS Local Area Unemployment Statistics; poverty, broadband, and educational attainment from Census ACS 5-Year Estimates. Joined on a five-digit FIPS code and year.

Variables (0–100 scale). Annual unemployment rate; poverty rate (B17001); broadband subscription rate (B28002); bachelor's-or-higher attainment (B15003).

Methods. Pearson correlation, Spearman rank correlation, and OLS multiple regression with all three predictors entered jointly, per year, and pooled. Computed with *MathNet.Numerics*.

System. A reproducible RESTful Web API in .NET 10 / ASP.NET Core, Clean Architecture, PostgreSQL via Entity Framework Core. The data ingestion and analysis pipeline is shown in Figure 1.

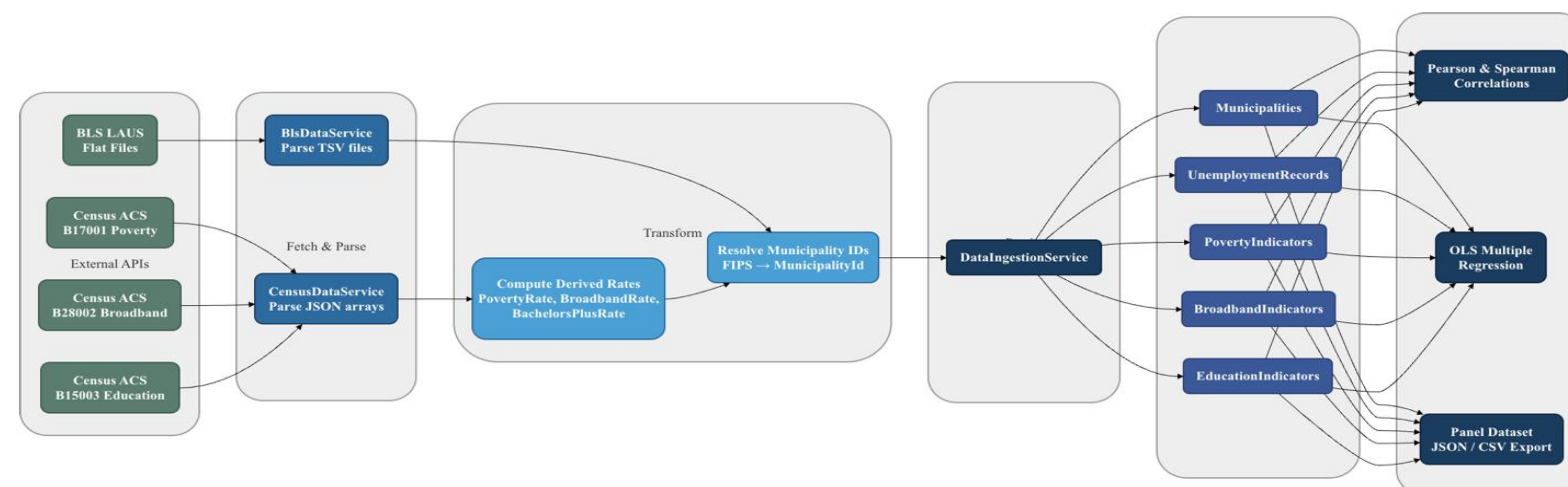


Figure 1. Data ingestion and analysis pipeline: external sources are parsed, transformed into derived rates, persisted as a municipality-year panel, and analyzed.

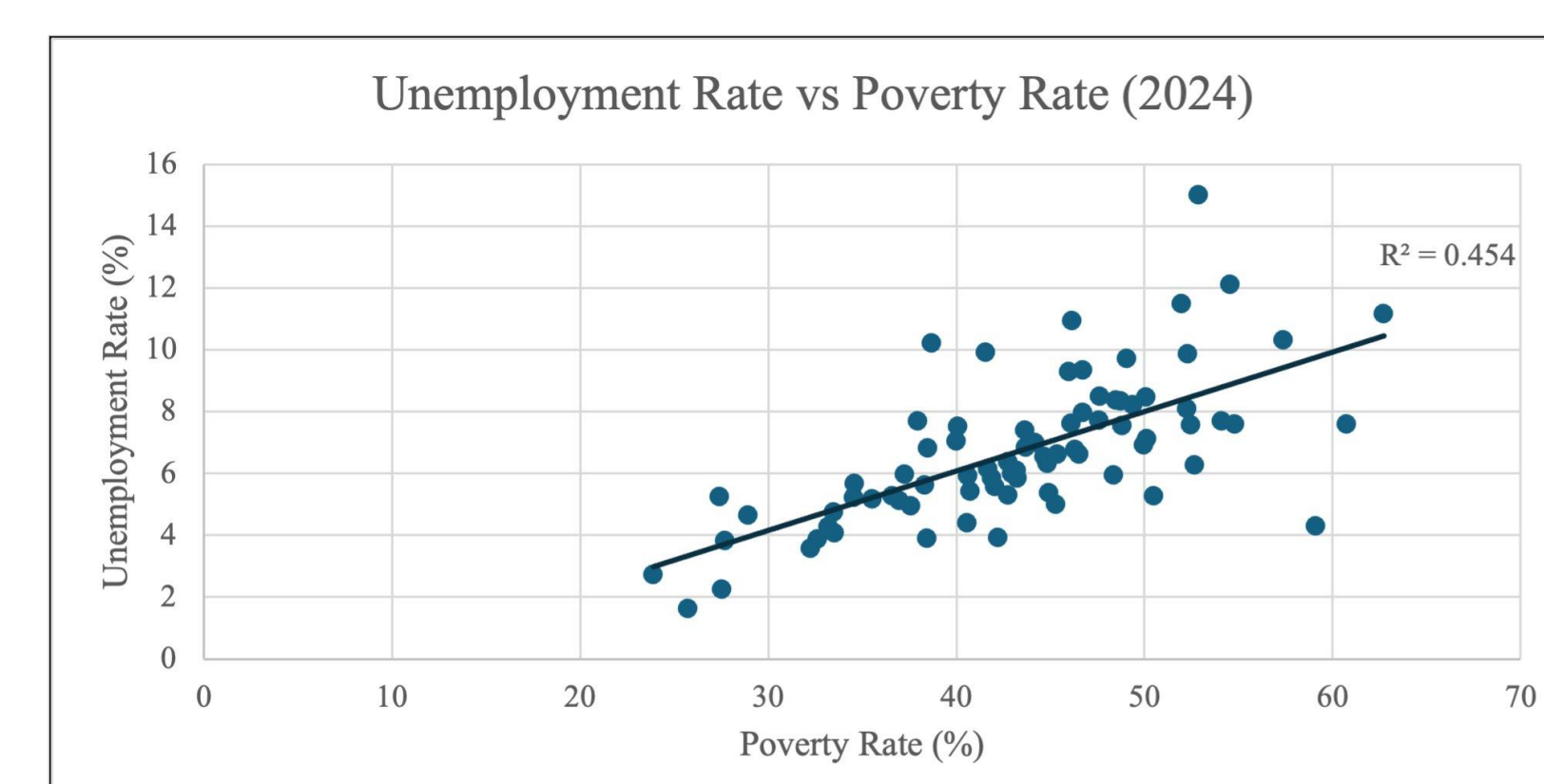


Figure 2. Municipal unemployment vs. poverty rate, 2024 (n = 78), with OLS trend line.

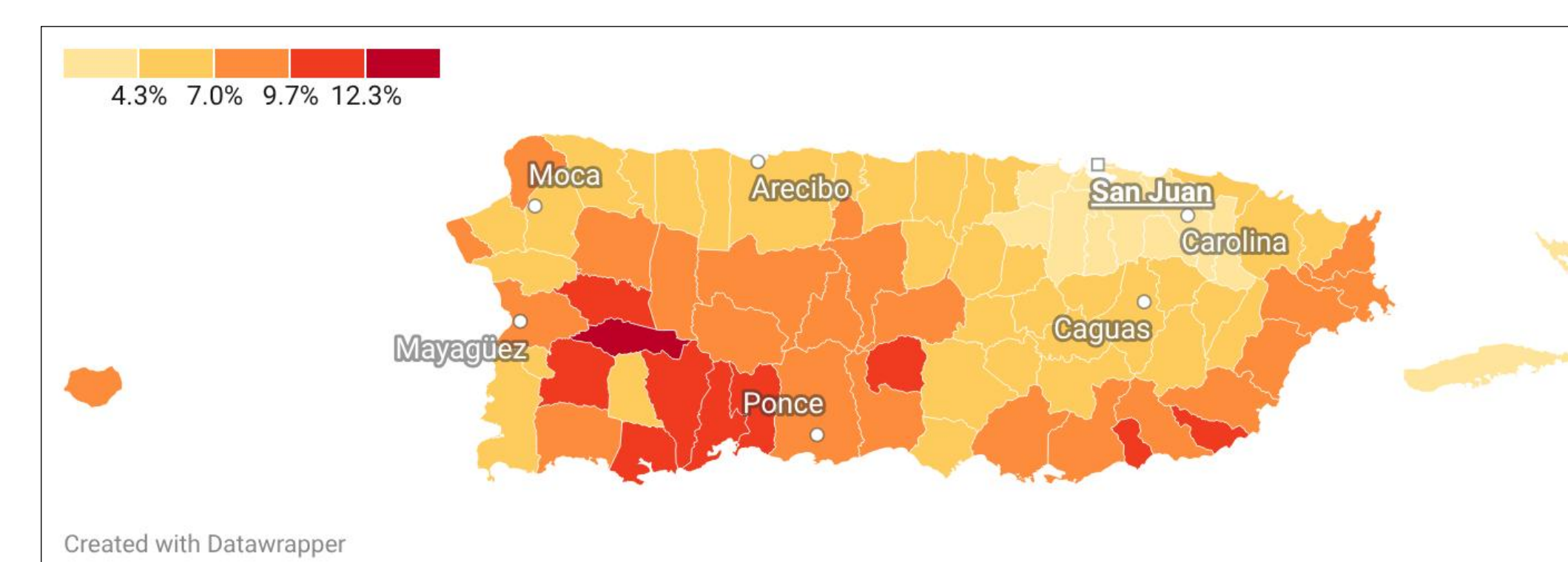


Figure 3. Unemployment rate by municipality, 2024. Darker shading = higher unemployment.

Results and Discussion

Model fit. $R^2 = 0.440\text{--}0.489$ annually; pooled $R^2 = 0.471$ — the model explains roughly half of cross-municipal variation.

Poverty — dominant correlate. Positive and highly significant ($p < 0.001$) every year and pooled. A 10-point rise in poverty is associated with ~ 1.5 additional points of unemployment. Robust to the COVID-19 shock.

Education — bivariate but not joint. Strong bivariate correlation ($r = -0.44$ to -0.56) but insignificant once poverty enters; the poverty–education correlation ≈ -0.69 .

Broadband — strengthening. Effectively zero in 2019, strengthening to $\beta = -0.055$ ($p < 0.001$) pooled — consistent with the rising role of digital infrastructure during COVID-19.

Geographic structure. Sharply bimodal. The five municipalities with the highest unemployment rates (Maricao 15.02%, Maunabo, Arroyo, Guánica, Guayanilla) cluster in the south and southwest; the San Juan metro core has the lowest rates. The pattern is persistent.

Conclusions

Poverty is the dominant correlate of municipal unemployment in Puerto Rico — a stable, strongly positive association in every year and pooled. Education correlates bivariately but operates principally through poverty; broadband shows a moderate negative effect that strengthens to pooled significance. The findings extend prior literature into a small, fiscally constrained U.S. territory and prove robust to shocks including COVID-19. They support geographically targeted investment — poverty alleviation and broadband expansion — in the highest-unemployment municipalities, via a fully reproducible analytical pipeline.

Future Work

Research: move from correlation toward causation with panel methods using municipal fixed effects, instrumental-variable designs, and spatial controls; extend the panel as new BLS and Census data are released. Software: build a bilingual (English/Spanish) interactive frontend over the API for exploring municipal labor-market data, toward a generic federal-data exploration platform.

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