Multifactorial Analysis of Demographic, Economic, and Educational Influences on U.S. Voting Patterns, 2016-2020

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Research Question

How did the relationship between county-level demographic factors, education levels, and unemployment rates and the Democratic vote share change between the 2016 and 2020 presidential elections?

Hypotheses

- **H1:** Counties with increasing racial diversity will show a positive change in Democratic vote share from 2016 to 2020.
- **H2:** The impact of education levels on Democratic vote share will vary across income groups, with a stronger positive relationship in higher-income counties.
- **H3:** Counties with higher unemployment rates in 2016 will show a negative change in Democratic vote share in 2020.
- **H4:** There will be significant interaction effects between education levels and racial demographics on Democratic vote share.

Data Sources

- Demographic Data: Racial composition, median household income
- Education Data: Educational attainment for individuals 25 and older
- Unemployment Data: County-level rates for 2012 and 2016
- Election Results: Democratic vote share in 2016 and 2020 presidential elections

Key Findings

- H1 (Diversity): Supported for counties with larger Dem vote share increases, contradicted for counties with decreases
- H2 (Education): Partially supported, with stronger effects in counties with larger Dem vote share increases
- H3 (Unemployment): Strongly supported across all levels of Dem vote share change
- H4 (Interactions): Complex relationships confirmed, particularly for diversity and education

Geographic Analysis

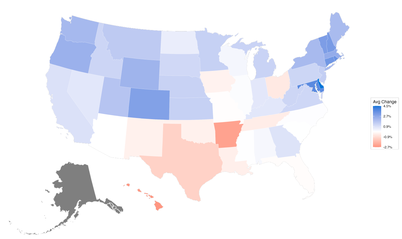

Figure 1. Average Change in Democratic Vote Share by State (2016-2020)

- Clear regional divide: Northeast and West show increases, South and parts of Midwest show decreases
- Key swing states (MI, WI, PA) show positive changes for Democrats
- Some traditionally Republican states (AZ, GA) show increases in Democratic vote share

Demographic Analysis

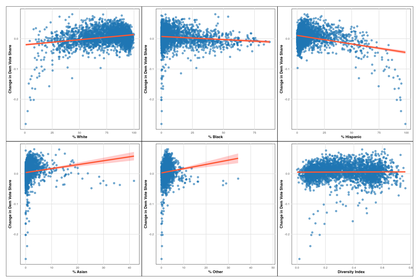

Figure 2. Change in Democratic Vote Share vs. Racial Demographics (2016-2020)

- White population percentage shows a negative correlation with Democratic vote share change
- Black and Hispanic populations show positive correlations, but with varying strengths
- Asian population demonstrates a weak positive relationship
- Overall diversity index suggests a complex, non-linear relationship with vote share change

Time Series Analysis

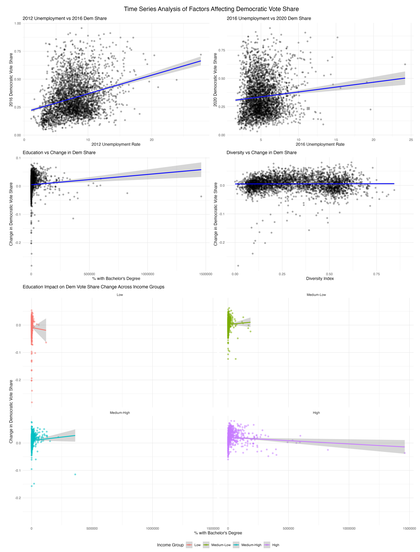

Figure 3. Time Series Analysis of Unemployment and Democratic Vote Share

- 2012-2016: Positive relationship between unemployment and Democratic share
- 2016-2020: Weaker positive relationship
- Education shows slight positive relationship with Democratic vote share change
- Diversity alone not a strong predictor of vote share change

Random Forest & XGBoost

Table 1. Top 5 Features by Importance

Feature	RF Importance	XGB Importance
median_household_income	39.46	0.19
bachelor_degree	53.44	0.18
pct_black	36.54	0.10
pct_asian	30.40	0.11
pct_hispanic	31.20	0.09

RandomForest model: RMSE = 0.0157, R2 = 0.4524

- Education (bachelor's degree) and income are the most important predictors
- Racial demographics show moderate importance
- Machine learning models capture non-linear relationships and interactions
- Models explain about 45% of the variance in Democratic vote share change

Regional Analysis

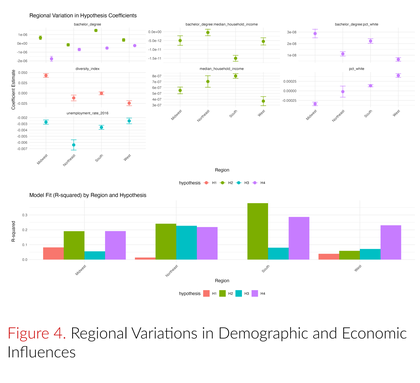

Figure 4. Regional Variations in Demographic and Economic Influences

- Unemployment effect strongest in Northeast and South
- Education effect varies by region: positive in Midwest and South, negative in Northeast and West
- Racial demographics show varied effects across regions

Regional Differences:

- Northeast: Strong negative unemployment effect, weak education effect
- Midwest: Moderate effects for both unemployment and education
- South: Strong negative unemployment effect, strong positive education effect
- West: Weak unemployment effect, moderate negative education effect

Quantile Regression Insights

- Unemployment: Consistent negative effect across all quantiles
- Education: Increasing positive effect for higher quantiles
- Diversity: Shift from negative to positive effect as quantiles increase

Results Robustness Checks

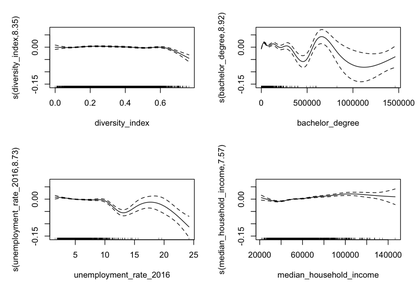

Figure 5. Non-linear Effects on Change in Democratic Vote Share

- All variables show significant non-linear relationships ($p < 0.001$)
- Model explains 30.6% of deviance in Democratic vote share change
- Adjusted R-squared: 0.299
- Variable Effects:
  - Bachelor's Degree (edf: 8.920)
  - Unemployment Rate 2016 (edf: 8.728)
  - Diversity Index (edf: 8.350)
  - Median Household Income (edf: 7.572)
- Simple linear models may not capture the full complexity of voting behavior

Conclusion

- Demographic, economic, and educational factors show complex, non-linear relationships with voting patterns
- Significant regional variations highlight the importance of local context
- Machine learning models reveal intricate interactions between factors
- The impact of diversity, education, and unemployment on voting patterns varies across different quantiles of Democratic vote share change

Links

- Code & Data
- Poster
- Presentation