Driving Transportation Justice Through M.A.'s MOR-EV Rebate Policy

Vivian Mai

Research inquiries:

To what extent does Massachusetts' MOR-EV rebate policy support transportation justice in the state?

Are rebate resources allocated equitably?

1. Introduction
2. Existing Policy Programs
3. MOR-EV and Visualizing Energy
4. Data Analysis + Limitations
5. Results
6. DOER Conversation
7. Policy Recommendations

Introduction.

Project Goals

Existing Policies

What are the policies in place, and how effective are they at reaching low-income communities?

Rebate Effectiveness

What did the rebates address?

Identify Patterns

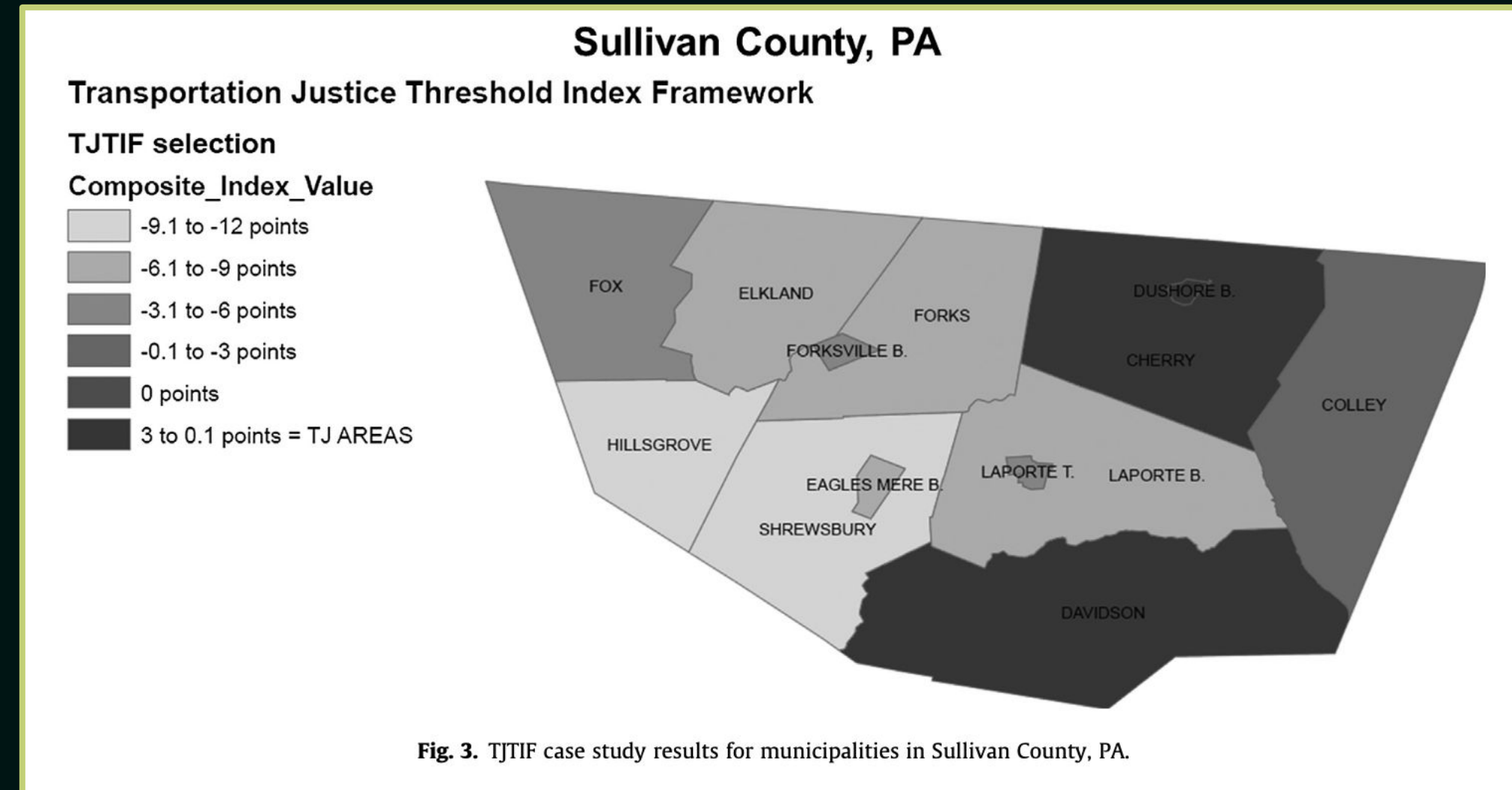What are the correlations based on data analysis?

Transportation Equity

"Equity in transportation seeks fairness in mobility and accessibility to meet the needs of all community members. A central goal of transportation is to facilitate social and economic opportunities by providing equitable levels of access to affordable and reliable transportation options based on the needs of the populations being served, particularly populations that are traditionally underserved" (U.S. Department of Transportation)
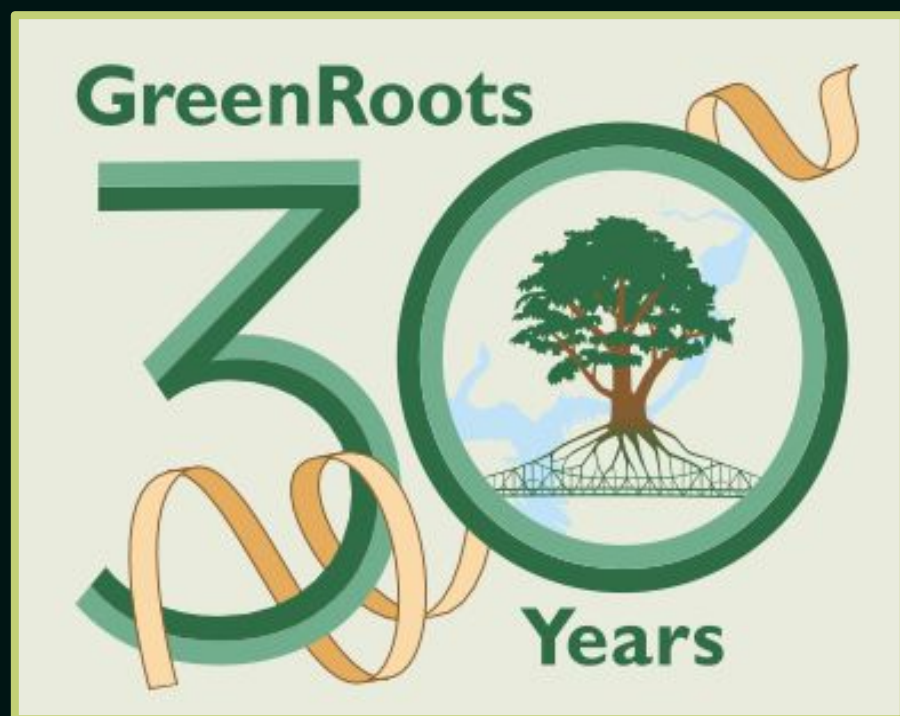
Transportation Justice

"Transportation justice describes a normative condition in which no person or group is disadvantaged by a lack of access to the opportunities they need to lead a meaningful and dignified life. It involves transforming the structures and processes that lead to the inequitable distribution of transportation's multiple externalities (e.g., noise, pollution, visual intrusion, risk of bodily harm, and exposure to law enforcement, among others) across populations and space. Also essential to this notion of transportation justice is that residents and other stakeholders should be able to actively participate in and influence the decisions that affect their lives" (Karner et. al, 2020)

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Transportation Justice Threshold Index Framework

- (1) reduce adverse human health and environmental effects on minority and low-income populations
- (2) include all potentially affected communities in the transportation decision-making process
- (3) ensure that minority and low-income populations receive equitable benefits
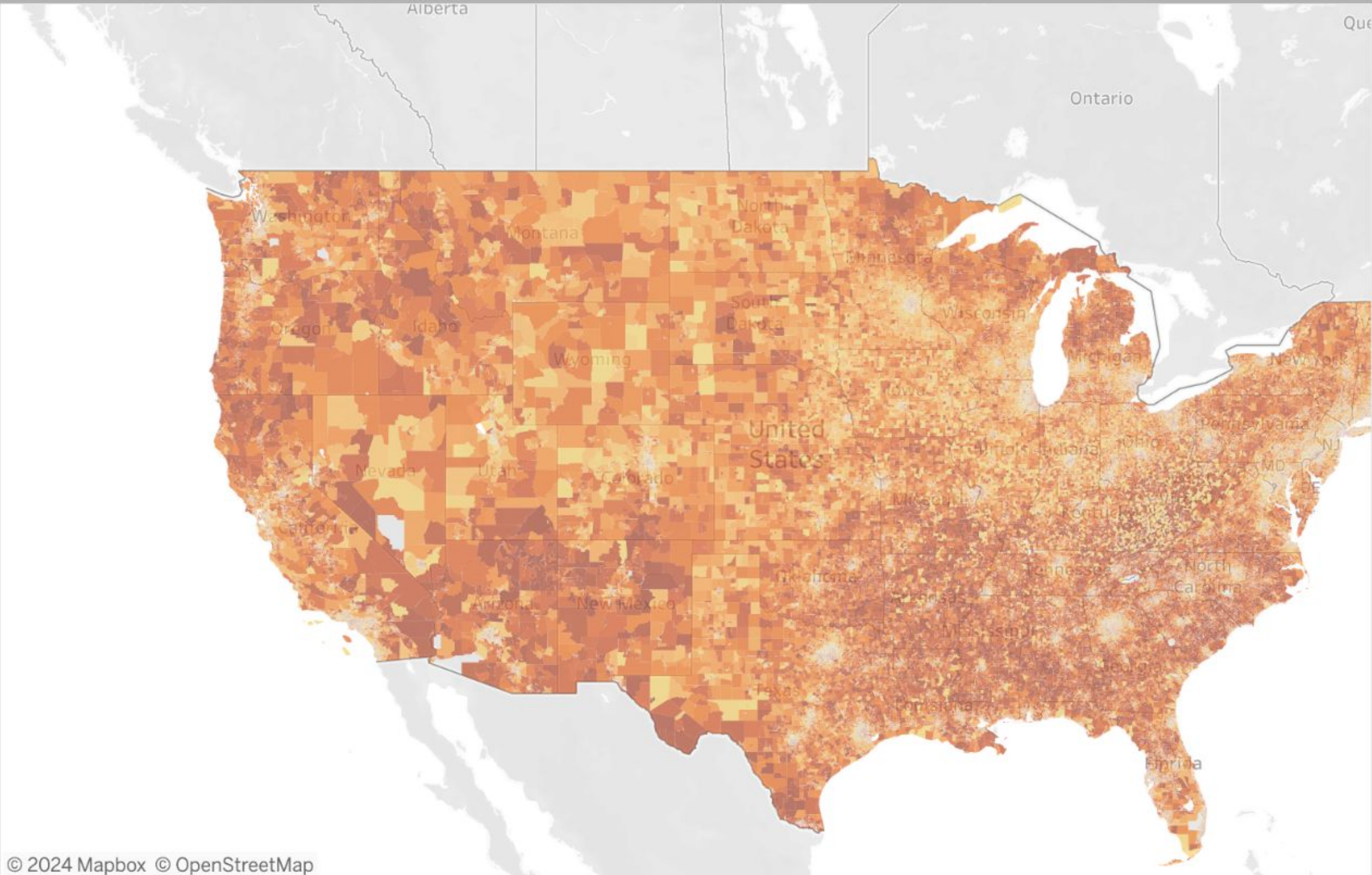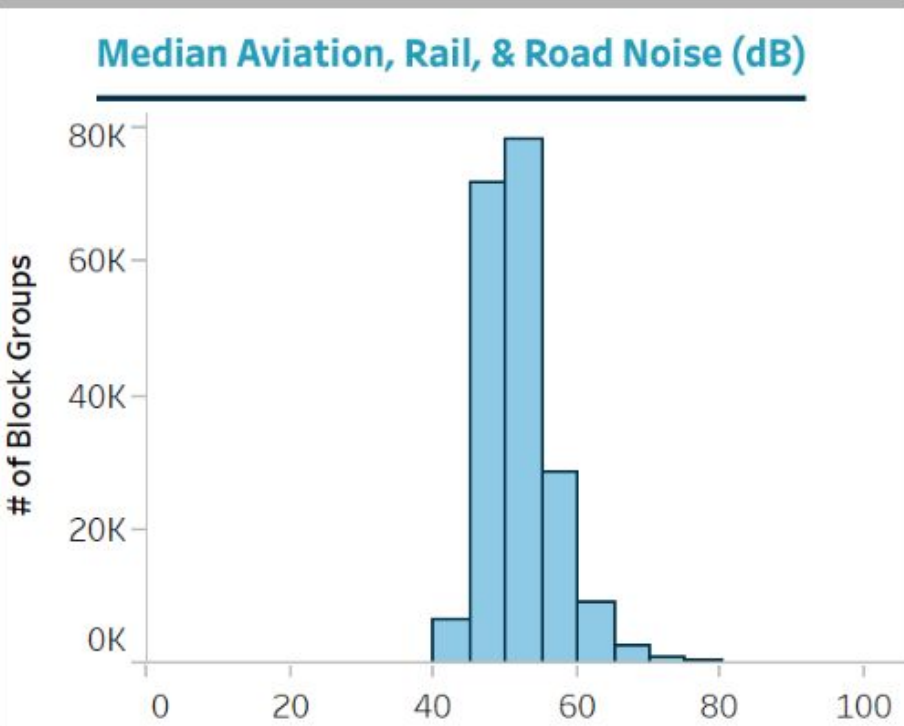- → index approach

Sullivan County, PA

Transportation Justice Threshold Index Framework

TJTIF selection

Composite_Index_Value

- -9.1 to -12 points
- -6.1 to -9 points
- -3.1 to -6 points
- -0.1 to -3 points
- 0 points
- 3 to 0.1 points = TJ AREAS

Fig. 3. TJTIF case study results for municipalities in Sullivan County, PA.

Existing Policy Programs.

TransportSE: *Transport*ation for *S*ocial *E*quity

A prototype screening tool to visualize national percentile ranks of all continental U.S. census block groups and a composite social vulnerability metric. Use the tool to explore the relationships between select indicators of transportation burdens, census demographic metrics, and social vulnerability. The tool can be customized with additional equity factors and transportation indicators, or rescaled to different geographies.

U.S. Department of Transportation
Volpe Center

EXPLORING THE DATA

COMPOSITE METRIC MAP

CONTACT THE TEAM

STATE
(All)

COUNTY
(All)

METRO AREA
(All)

Composite Metric: Social Vulnerability

# of Block Groups

Median Aviation, Rail, & Road Noise (dB)

# of Block Groups

© 2024 Mapbox © OpenStreetMap

PM 2.5 Level in Air

Percentile (% Low Income)

Percentile (% MInority)

Percent (No Car Ownership)
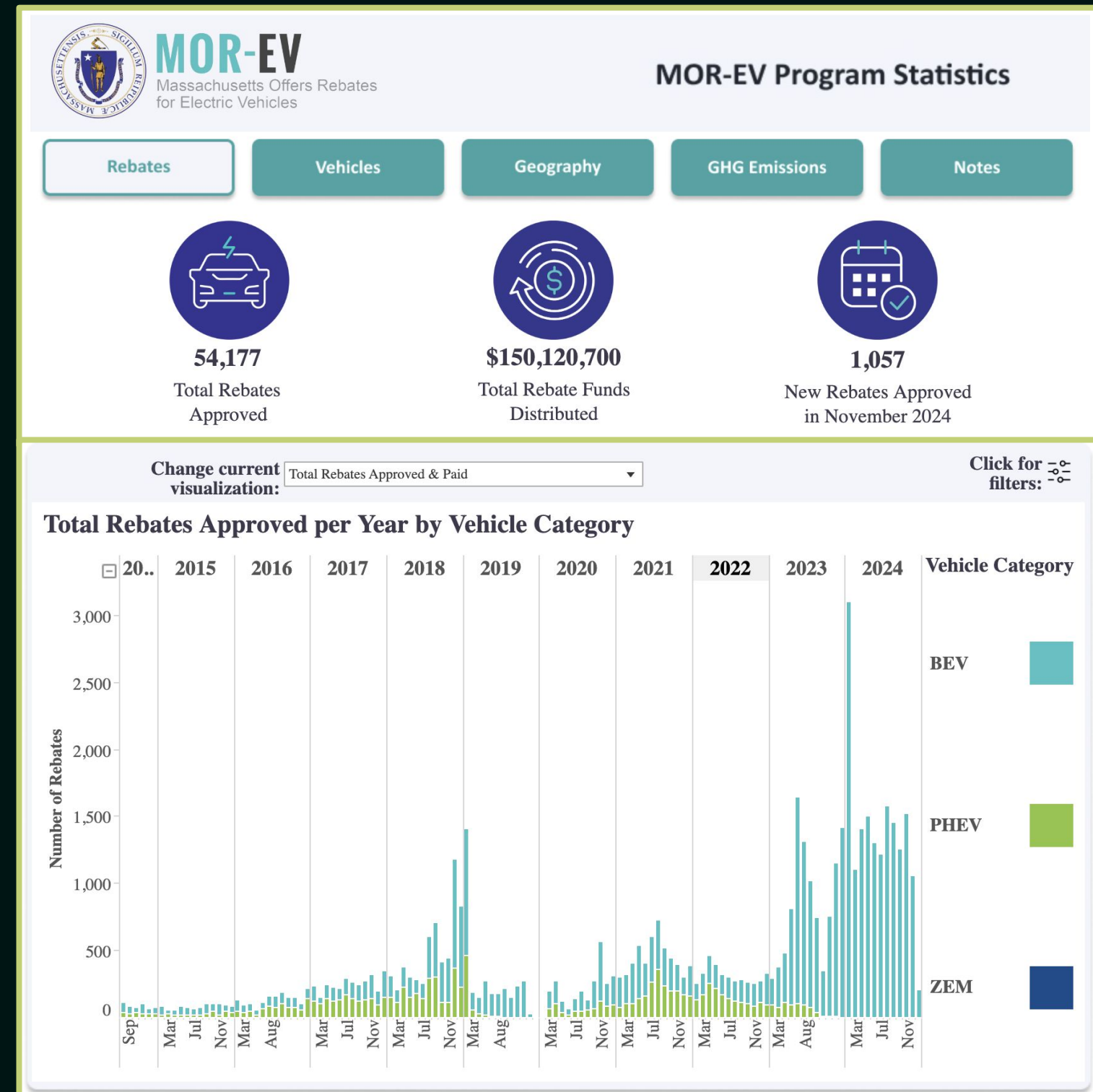
MOR-EV and Visualizing Energy.
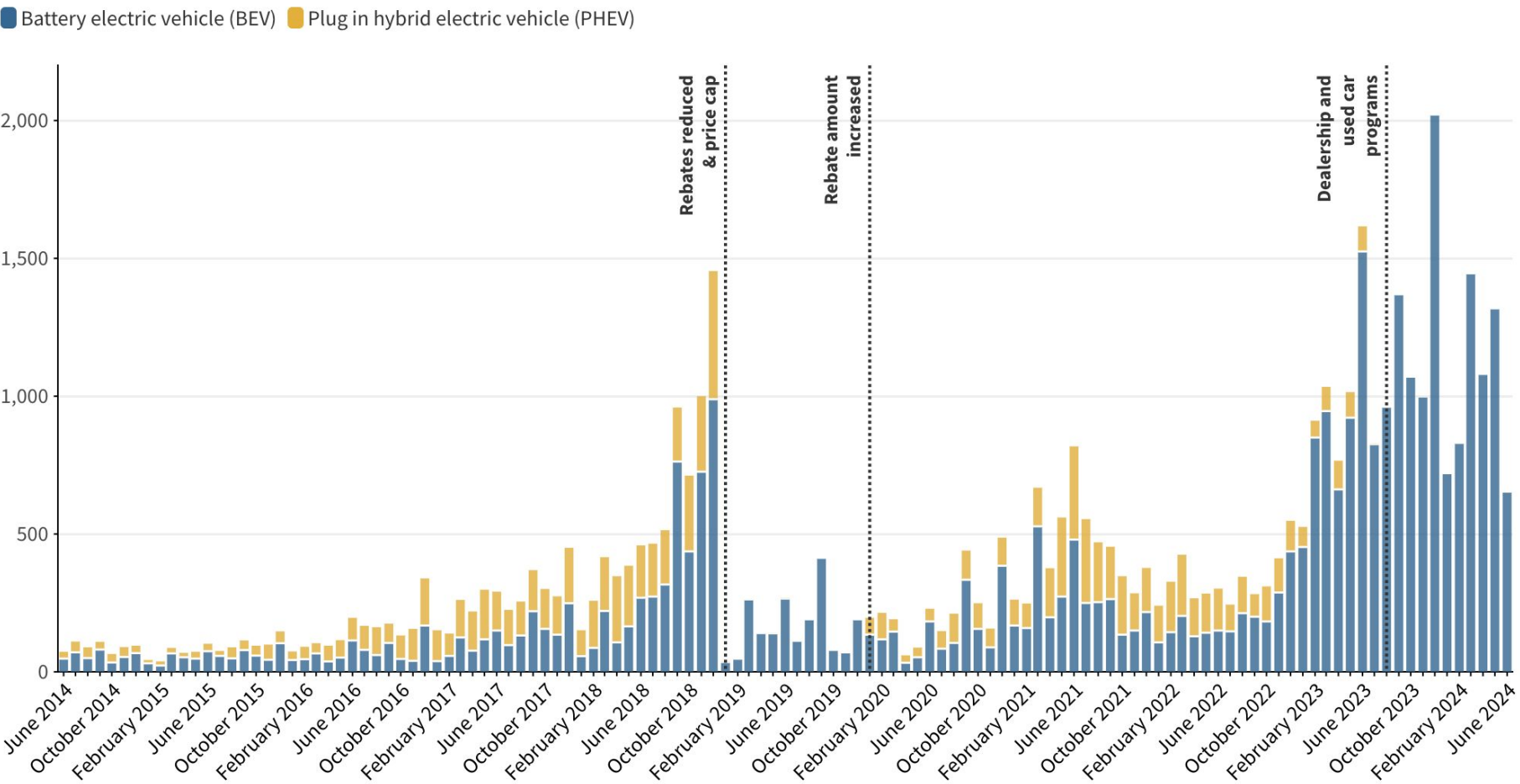
MOR-EV

Electric Vehicles for Everyone

MOR-EV is dedicated to making electric vehicles (EVs) more affordable for Massachusetts residents, businesses and non-profit organizations to help achieve clean transportation goals and reduce greenhouse gas emissions, and provide more equitable access to EVs. The program is funded by the Executive Office of Energy and Environmental Affairs' Department of Energy Resources (DOER) and administered statewide by the Center for Sustainable Energy (CSE).

To assure greater participation in the EV transition, MOR-EV now includes the following program elements:
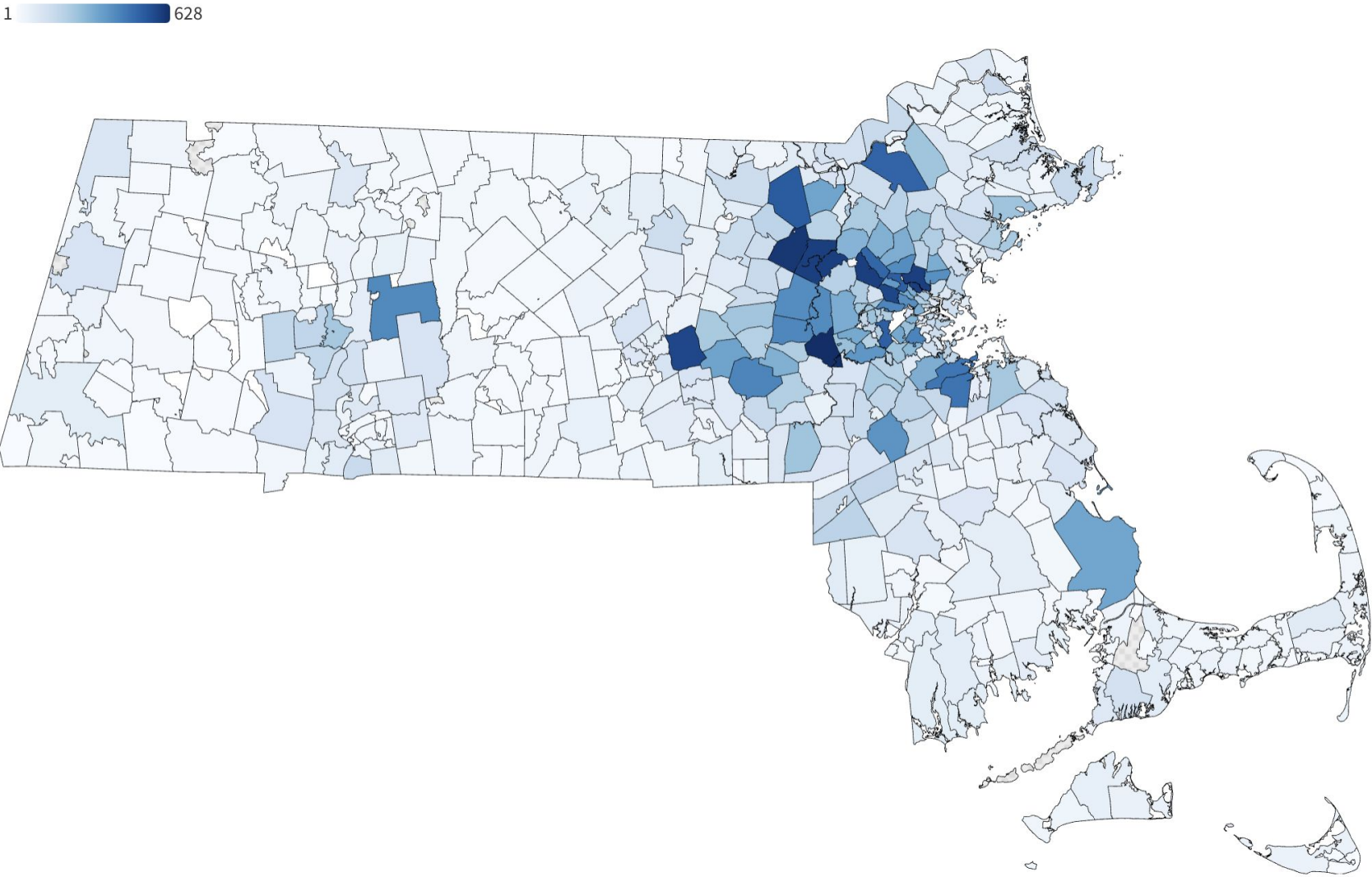
- $3,500 rebates are available for new or used cars.

- Income-qualifying drivers can receive an additional rebate of $1,500.

- $1,000 additional rebate for trading-in a qualifying vehicle.

- Rebates for new and used EVs are available at the time of purchase or lease at participating dealerships as well as after an eligible purchase or lease.

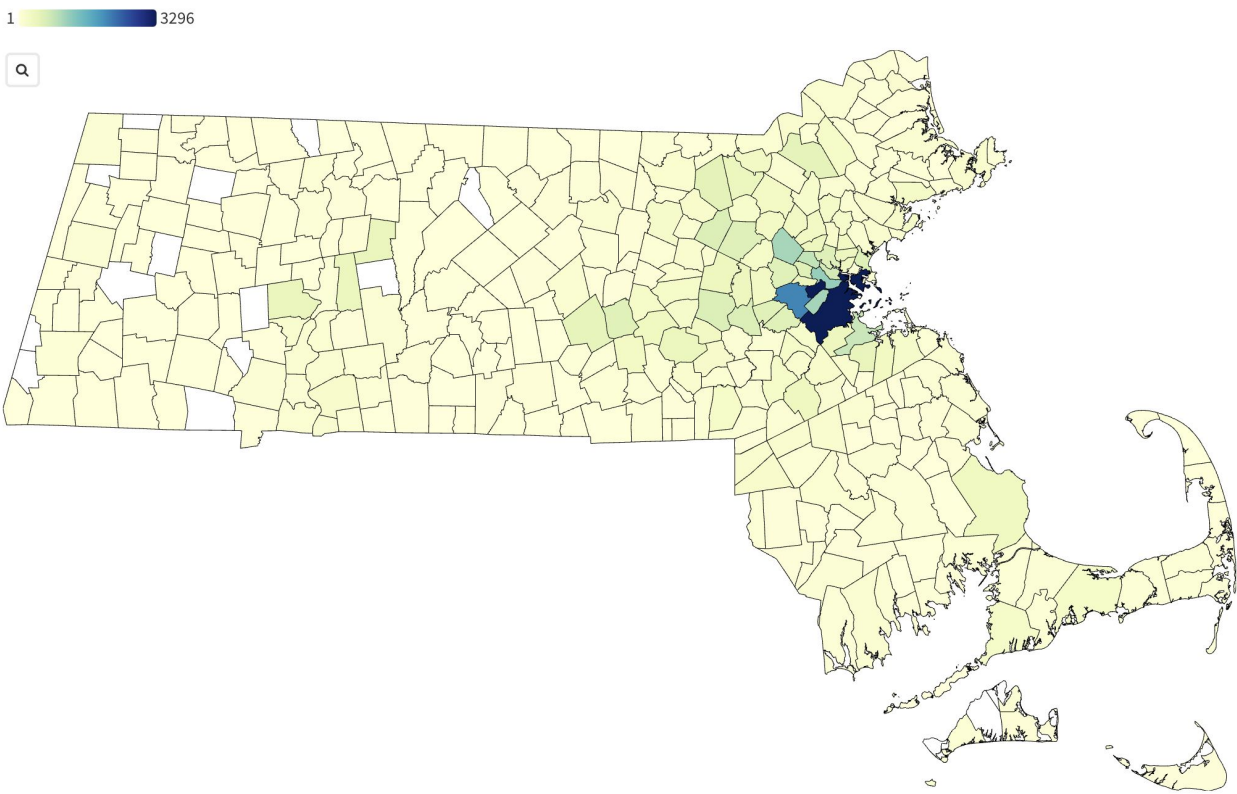- The MOR-EV Trucks programs provide rebates for pick-up trucks and Class 2b vehicles as well as Class 3-8 vehicles.

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Rebates for electric passenger vehicles by vehicle category, 2014–2024

■ Battery electric vehicle (BEV) ■ Plug in hybrid electric vehicle (PHEV)

Rebates reduced & price cap

Rebate amount increased

Dealership and used car programs

Rebates for electric passenger vehicles by ZIP Code, 2014–2024

1 — 628

Rebates for electric passenger vehicles by municipality, 2014–2024

1 — 3296

Visualizing Energy

Data Analysis + Limitations.

Methods

Data Origin

- Dollar amount of rebate, application year, and applicant county variables: MOR-EV
- Municipality, county, fiscal year, income per capita, and population variables: Department of Revenue

Software

- STATA package

Statistical Tests

- Hypothesis test (two sample t-test)
- Fixed-effect multivariate regression
- Visualizations: box plots and bar charts

Rebate Distribution

- Which demographic within a county or municipality receives the money?

Geographic Trends

- Intra-county or intra-municipality disparities

Income Grouping

- High vs. low income groups

Confounding Variables

- EV infrastructure availability, awareness of program, and community engagement levels

Limitations

Data Analysis

Table 1. Two-Sample T-Test Results Comparing High-Income and Low-Income Groups

```
Two-sample t test with equal variances

  Group  │     Obs        Mean     Std. err.    Std. dev.    [95% conf. interval]

High Inc │  48,666    2761.177    3.947759     870.8904      2753.44     2768.915
Low Inco │   2,657    2106.229    11.43539     589.4496     2083.806     2128.652

Combined │  51,323     2727.27    3.843639     870.7602     2719.737     2734.804

   diff  │             654.9484   17.10543                  621.4216     688.4752

    diff = mean(High Inc) - mean(Low Inco)                         t =   38.2889
H0: diff = 0                                    Degrees of freedom =     51321

    Ha: diff < 0                  Ha: diff != 0                    Ha: diff > 0
 Pr(T < t) = 1.0000       Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
```

Null Hypothesis (H_o): The mean rebate amount for the high-income group is equal to the mean rebate amount for the low-income group (No difference in means).

Alternative Hypothesis (H_a): The mean rebate amount for the high-income group is greater than that for the low-income group.

Table 2. Fixed-Effects Regression Results for Total Rebate Amount


```
Fixed-effects (within) regression        Number of obs    =      1,404
Group variable: Municipali~D             Number of groups =        351

R-squared:                               Obs per group:
    Within  = 0.5488                                     min =          4
    Between = 0.0052                                     avg =        4.0
    Overall = 0.2707                                     max =          4

                                         F(2, 1051)       =     639.05
corr(u_i, Xb) = -0.6960                  Prob > F         =     0.0000

─────────────────────────────────────────────────────────────────────────────
       Total_Amount │ Coefficient  Std. err.      t    P>|t|   [95% conf. interval]
────────────────────┼────────────────────────────────────────────────────────────
DOR_Income_Per_Capita│  .0218275    .000735    29.70   0.000    .0203852    .0232698
          Population │  .0080535   .0008833     9.12   0.000    .0063203    .0097866
               _cons │    2737.7    101.373    27.01   0.000    2538.783    2936.616
────────────────────┼────────────────────────────────────────────────────────────
             sigma_u │  2067.9417
             sigma_e │  2106.4439
                 rho │  .49077735   (fraction of variance due to u_i)
─────────────────────────────────────────────────────────────────────────────
F test that all u_i=0: F(350, 1051) = 1.98          Prob > F = 0.0000
```
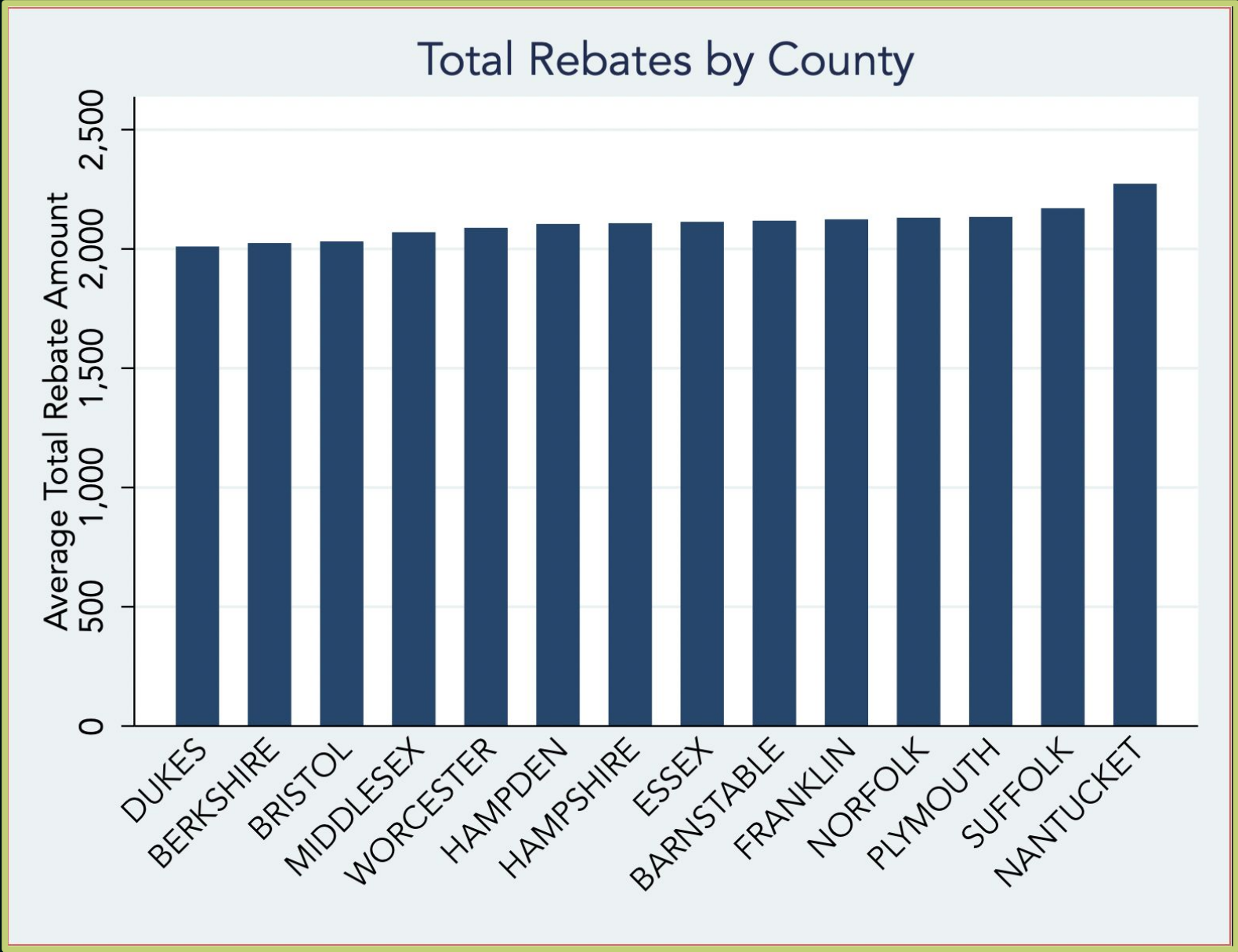
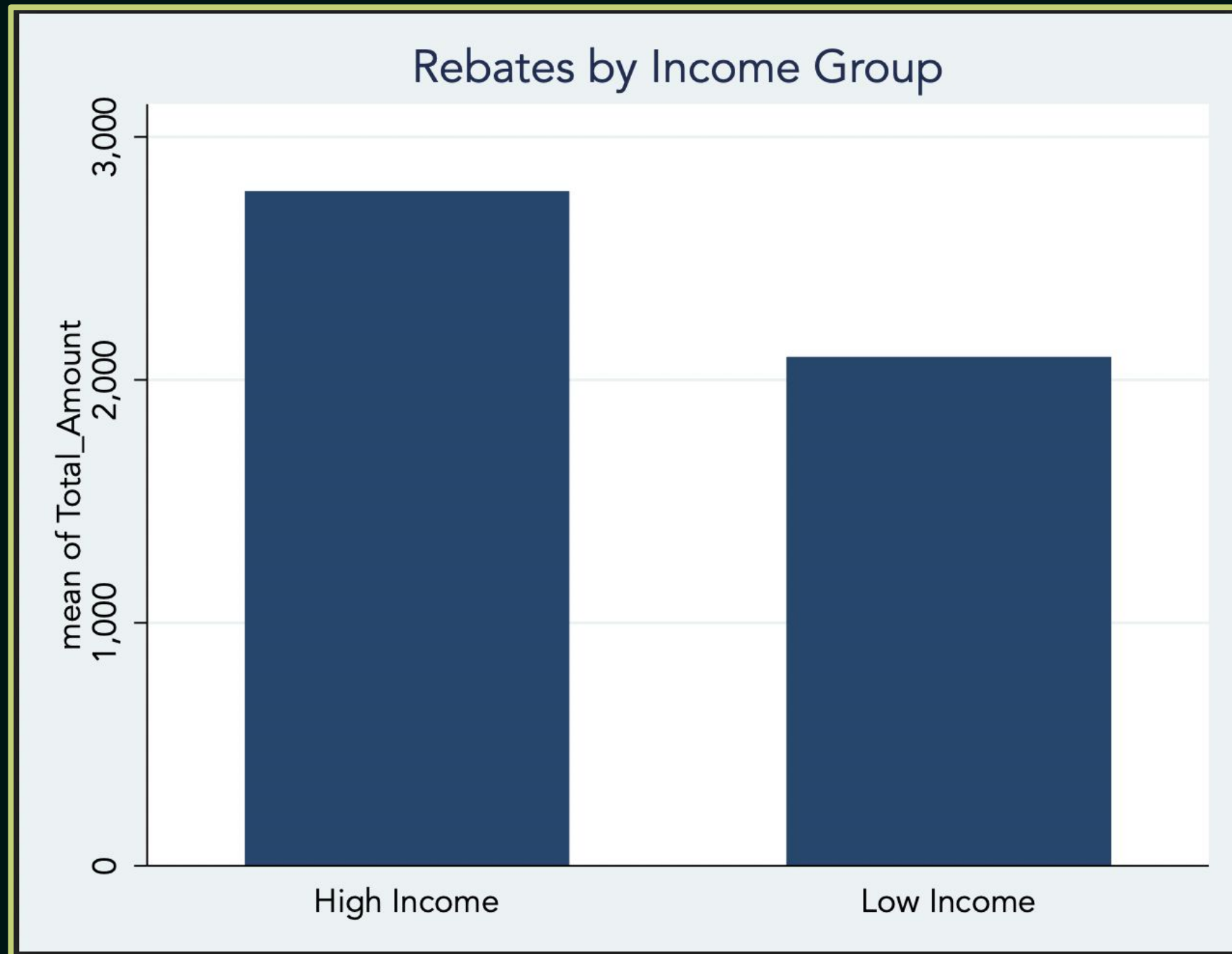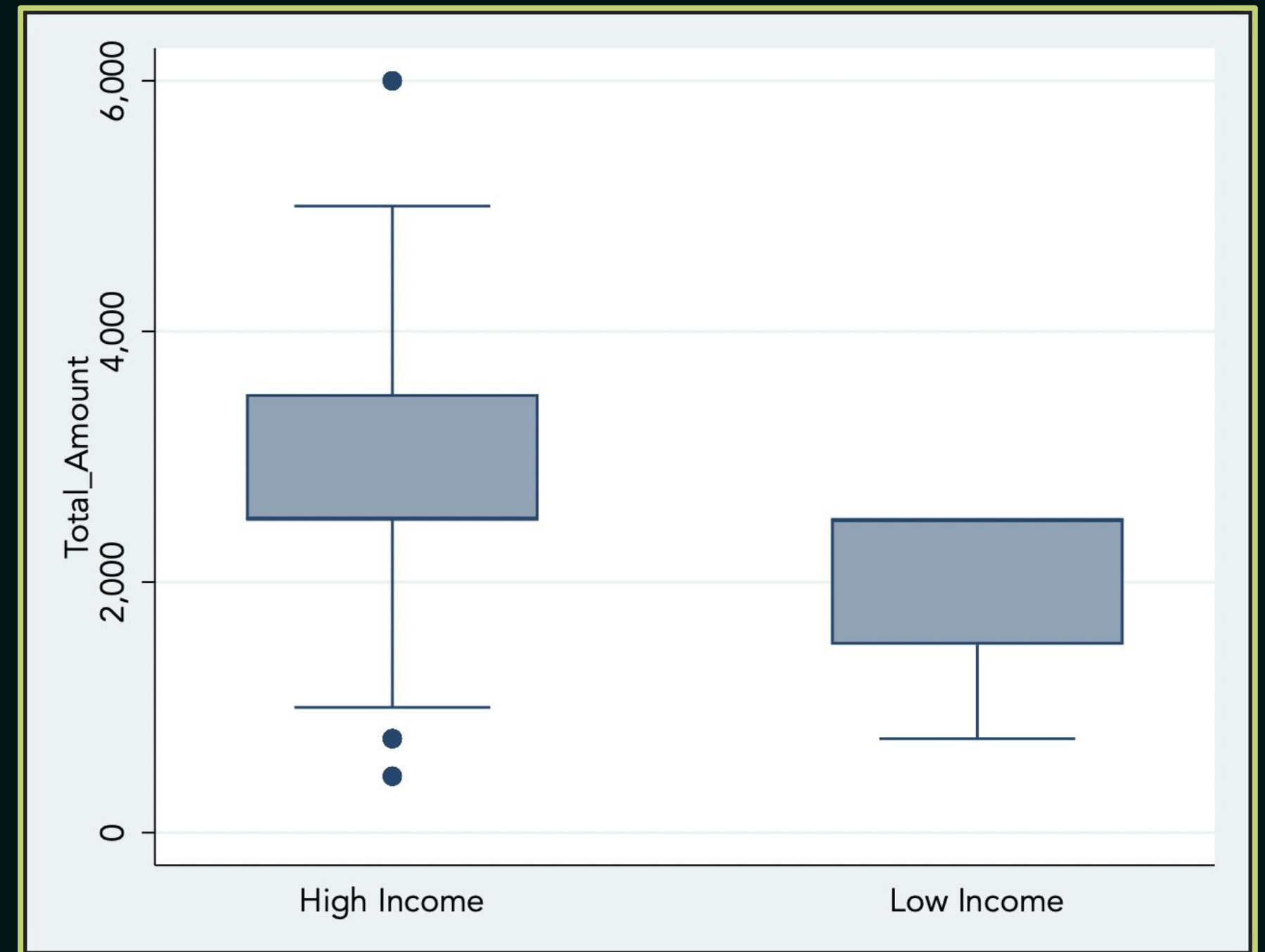Figure 1. Average Total Rebates by County

Data Analysis

Figure 2. Average total rebates by municipality with a $43070 median threshold.

Figure 3. Average total rebates by municipality by income group.
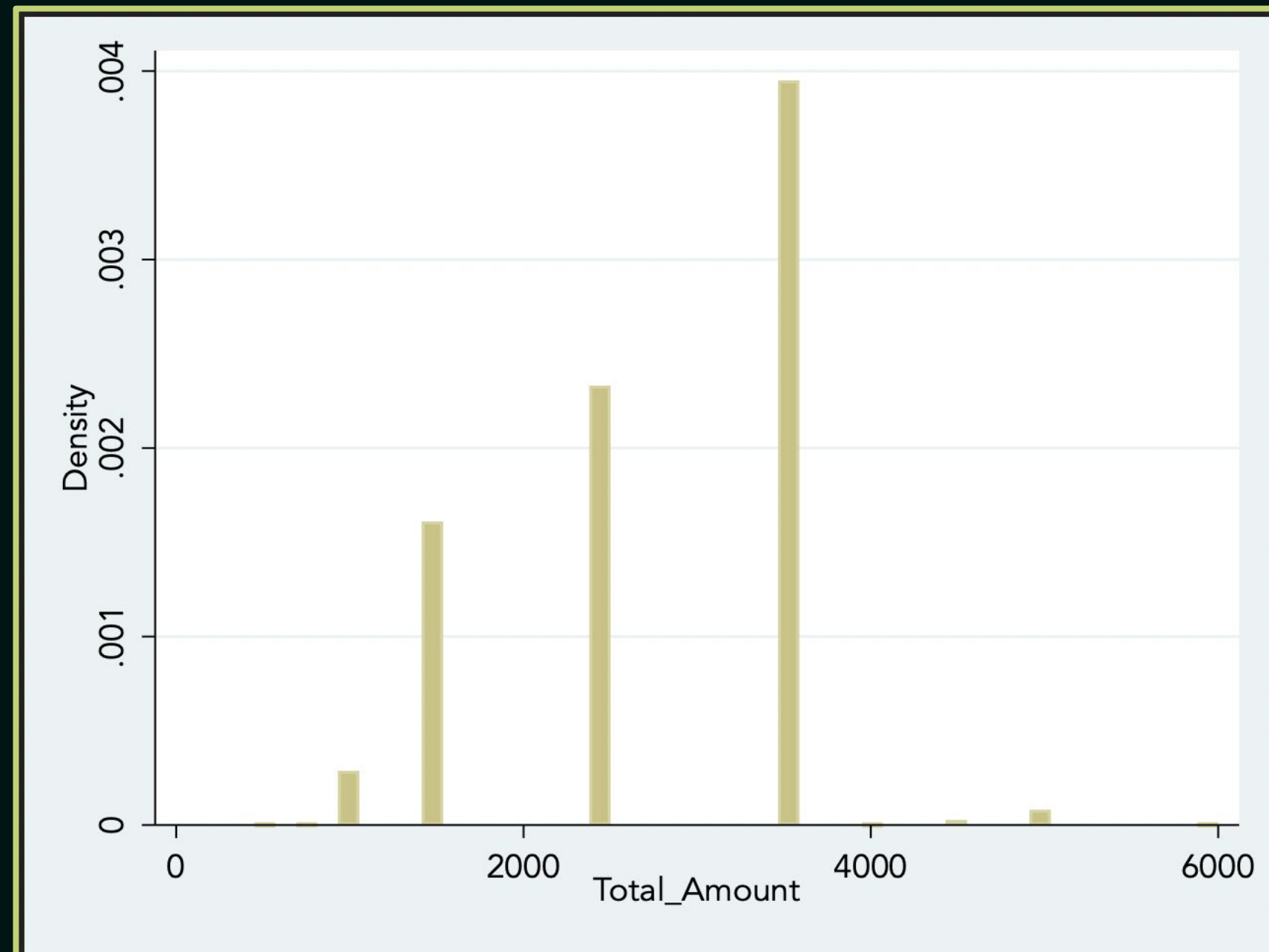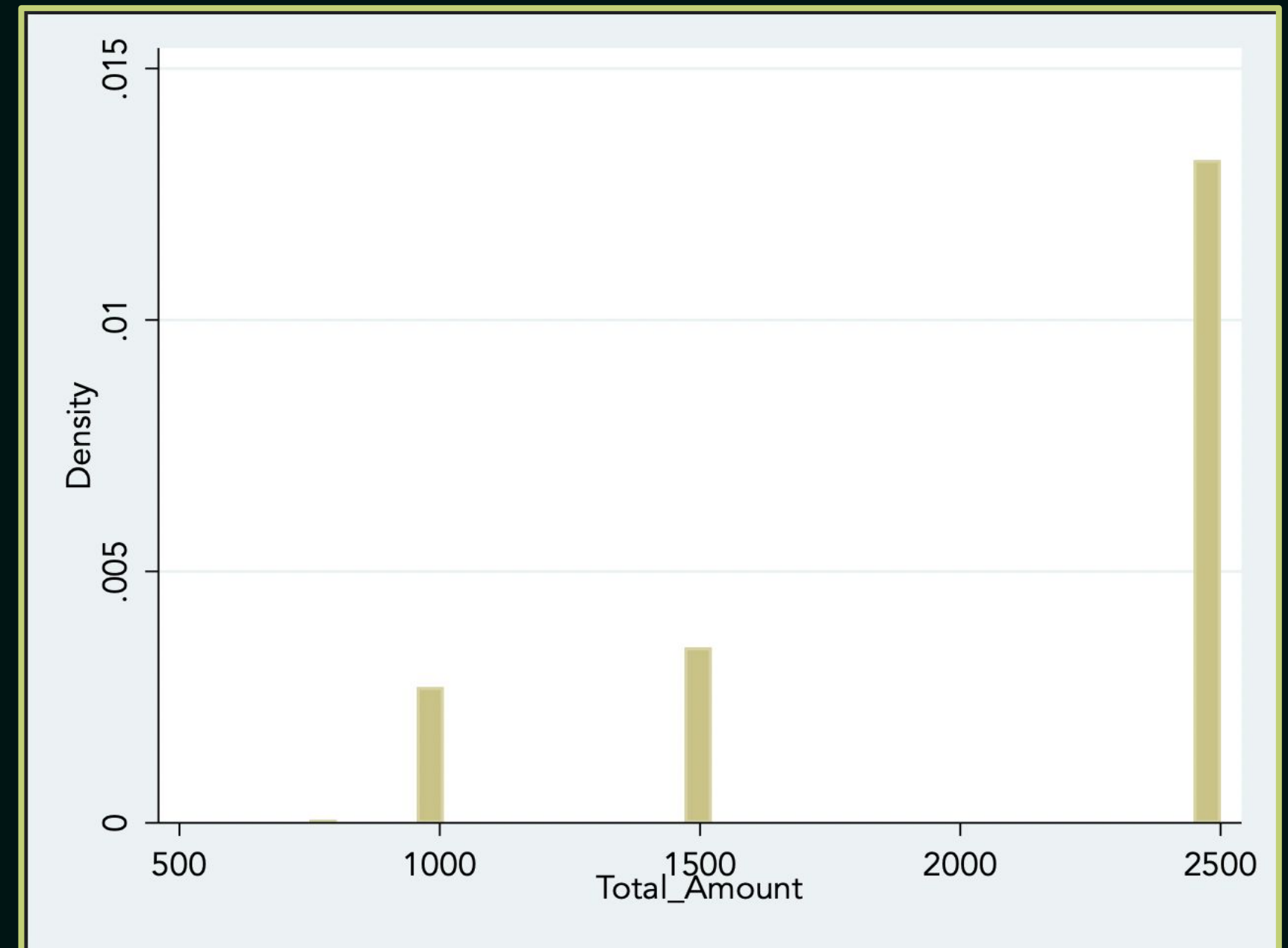
Data Analysis

Figure 4. Average total rebates by municipality with a "High Income" threshold.

Figure 5. Average total rebates by municipality with a "Low Income" threshold.

Data Analysis

Results.

```
Two-sample t test with equal variances

 Group        Obs        Mean      Std. err.    Std. dev.    [95% conf. interval]

High Inc    48,666     2761.177    3.947759     870.8904     2753.44      2768.915
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Pr(T < t) = 1.0000        Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
```

→ **mean rebate amount for high-income municipalities is significantly higher than for low-income municipalities**

→ difference of approximately $654.95 is meaningful and statistically significant

→ high-income municipalities receive more rebate money on average

→ **statistically significant association between the total amount of rebates and income per capita**
  → positive relationship indicates that wealthier municipalities receive higher rebates

→ **significant association between total amount of rebates and population**
  → positive relationship, meaning that municipalities with larger populations receive higher rebates

```
Fixed-effects (within) regression          Number of obs    =      1,404
Group variable: Municipali~D               Number of groups =        351

R-squared:                                 Obs per group:
    Within  = 0.5488                                    min =          4
    Between = 0.0052                                    avg =        4.0
    Overall = 0.2707                                    max =          4

                                           F(2, 1051)       =     639.05
corr(u_i, Xb) = -0.6960                     Prob > F         =     0.0000

       Total_Amount   Coefficient  Std. err.      t    P>|t|    [95% conf. interval]

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                  rho    .49077735   (fraction of variance due to u_i)

F test that all u_i=0: F(350, 1051) = 1.98                   Prob > F = 0.0000
```

DOER Conversation.

Policy Recommendations.

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Community Focus

Method

- What is the most effective way to reach communities and understand their needs?
  - surveys, focus groups, and public forums can provide critical qualitative data, etc...

Equitable Program Design

- Policymakers can incorporate feedback to redirect subsidies and resources to address specific needs

Participatory Approach

- Using a bottom-up approach to ensure that the clean energy transition is not only inclusive but also perceived as fair

Infrastructure Preferences

- What charging structures do communities prefer?

Existing EV Adoption Barriers

- Are people aware of subsidies?
- What about the affordability, charging access, or vehicle maintenance costs?

Incorporating TJTI

- Use frameworks or indexes to identify areas that would benefit from the rebate program and offer resources and assistance

Future Research Considerations

Thank you.

Special mention to...
→ Members of this forum for giving me the opportunity to share my work.
→ Catie Snyder and Morgan Bowler at the DOER for sharing your work at LBE.
→ Members of the Volpe Center for your resources and support.
→ Professor Reibstein for your continued guidance and trust in this project.