South American Publishing

SAP Transport, Mobility & Society. 2026;5:339
doi: 10.62486/tms2026339

ORIGINAL

# Commuting and car dependence across the rural-urban continuum of United States counties

## Conmutación y dependencia del automóvil en el continuo rural-urbano de los condados de Estados Unidos

**Edixon Chacón Guerrero**[1]

[1] Saint Mary's University, Texas, Estados Unidos

Submitted: 04-06-2026 | Revised: 11-08-2026 | Accepted: 09-10-2026 | Published: 11-10-2026

**Corresponding Author:** Edixon Chacón Guerrero

**ABSTRACT**

Introduction: Car dependence and long commutes are widely associated with rural residence, yet county-level evidence across the full rural-urban continuum of the United States is incomplete. Methods: Cross-sectional ecological analysis of all 3,144 United States counties and county equivalents using American Community Survey 2024 five-year estimates and the USDA Economic Research Service 2023 Rural-Urban Continuum Codes. Metropolitan (codes 1 to 3) and nonmetropolitan (codes 4 to 9) counties were compared with Welch t-tests, Spearman correlations and population-weighted sensitivity analyses. Results: Nonmetropolitan counties had shorter median commutes (18.6 versus 24.1 minutes; difference −5.5 minutes, 95% CI -5.9 to -5.1) and higher car dependence (76.8% versus 74.9% driving alone; difference 1.9 percentage points). County-level zero-vehicle household rates did not differ (0.2 percentage points, 95% CI -0.1 to 0.6), although population weighting reversed this result. Conclusions: Rural counties commute shorter distances but depend more on private cars; vehicle-less households concentrate in large cities, so rural and urban transport disadvantage take different forms.

Keywords: commuting; rural population; automobiles; transportation; United States.

**RESUMEN**

Introducción: La dependencia del automóvil y los desplazamientos largos se asocian con la residencia rural, pero falta evidencia a nivel de condado a lo largo del continuo rural-urbano de Estados Unidos. Métodos: Análisis ecológico transversal de los 3,144 condados y equivalentes de Estados Unidos con las estimaciones quinquenales 2024 de la American Community Survey y los códigos del continuo rural-urbano 2023 del USDA Economic Research Service. Los condados metropolitanos (códigos 1 a 3) y no metropolitanos (códigos 4 a 9) se compararon con pruebas t de Welch, correlaciones de Spearman y análisis de sensibilidad ponderados por población. Resultados: Los condados no metropolitanos tuvieron conmutaciones medianas más cortas (18,6 frente a 24,1 minutos; diferencia −5,5 minutos, IC 95% -5,9 a -5,1) y mayor dependencia del automóvil (76,8% frente a 74,9% que conducen solos; diferencia 1,9 puntos porcentuales). La proporción de hogares sin vehículo no difirió (0,2 puntos porcentuales, IC 95% -0,1 a 0,6), aunque la ponderación poblacional invirtió este resultado. Conclusiones: Los condados rurales conmutan distancias más cortas pero dependen más del automóvil privado; los hogares sin vehículo se concentran en las grandes ciudades, por lo que la desventaja de transporte rural y urbana adopta formas distintas.

Palabras clave: conmutación; población rural; automóviles; transporte; Estados Unidos.

© 2026; The Authors. This Open access article is distributed under CC BY 4.0 licence.

## INTRODUCTION

The private car dominates the journey to work in the United States, where most workers commute alone in a car, truck or van and only a small minority travels by public transport.(1)

Car dependence is most acute in rural areas, in which low densities, long distances to services and scarce public transport leave residents with few alternatives to the automobile.(2,3)

The result is a transport system in which the car functions not as a convenience but as a condition of participation in work, education and health care.(4,5)

In nonmetropolitan counties, public transport reaches few corridors, and the automobile is, for most working households, the only realistic means of reaching a job.(2,6)

Commuting carries a double meaning in rural America: it is the daily expression of car dependence and, at the same time, a mechanism that links dispersed rural populations to urban labour markets and regional service centres.(7)

Whether rural residents actually travel longer than urban residents to reach work is less settled than the image of the rural long-distance commuter suggests. Rural workers face long distances to employment and are sometimes portrayed as extreme commuters.(8)

Yet the longest average commutes concentrate in large metropolitan areas, where congestion, suburban sprawl and housing costs push workers outward from job-rich cores.(9,10)

Commuting geography has long treated rural areas as functional extensions of urban centres rather than as uniformly distant places.(7)

Average commute times in the United States have risen over recent decades, but the rise has been uneven across space and concentrated among low-income metropolitan workers.(10)

Individual travel surveys, whose rural samples are thin, answer the rural-urban question inconsistently, and the evidence from countries as different as India and the United States points in divergent directions.(11)

Commuting is therefore not only a question of engineering but of equity: the time, money and vehicles required to reach work determine who can participate in the labour market and at what cost.(5,10)

Most studies quantify rural mobility with household surveys or with case studies of single regions, which limits comparability across the whole settlement hierarchy. A county-level analysis of the complete United States using the Rural-Urban Continuum Codes offers two advantages. First, it covers every county without the sampling variability that weakens rural survey estimates. Second, it resolves the rural-urban distinction into nine ordered categories rather than a binary contrast, and therefore reveals gradients that a metropolitan-nonmetropolitan split conceals.(12)

The approach is deliberately descriptive and comparative rather than causal: the aim is to establish the size and direction of rural-urban differences with a national denominator, and to subject each difference to explicit sensitivity checks. The objective of this study is to compare commute time, car dependence and zero-vehicle household rates between metropolitan and nonmetropolitan counties of the United States, to quantify how these measures change across the nine rural-urban continuum categories, and to test whether the differences survive population weighting and the exclusion of small counties.

## METHODS

### Design and setting

Cross-sectional ecological study at the county level. The units of analysis were the 3,144 counties and county equivalents of the 50 United States and the District of Columbia for which both travel estimates and a rural-urban classification were available. Reporting followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cross-sectional studies.

### Data sources

Commuting and vehicle variables were obtained from the American Community Survey 2024 five-year estimates, which pool data collected between 2020 and 2024, through the Census Reporter interface.(1)

The American Community Survey is the standard source of county-level commuting statistics in the United States and underlies the small-area travel tabulations used by federal, state and local agencies. Three tables were retrieved for every county: B08301 (means of transportation

to work for workers aged 16 years and over), B08303 (travel time to work) and B08201 (household size by vehicles available). County-level rural-urban classification came from the 2023 Rural-Urban Continuum Codes of the USDA Economic Research Service.(13)

The two sources were merged on the five-digit Federal Information Processing Standards county code. All three tables were retrieved in a single vintage that covers every county, so the merged file reflects one consistent data release. Counties outside the 50 states and the District of Columbia, such as the island territories, were excluded because they lack a Rural-Urban Continuum Code.

The Rural-Urban Continuum Codes classify counties into nine categories that distinguish metropolitan counties by population size and nonmetropolitan counties by the size of their urban population and their adjacency to a metropolitan area.(13)

Code 1 denotes counties in metropolitan areas of one million population or more, code 2 counties in metropolitan areas of 250,000 to one million, and code 3 counties in metropolitan areas of fewer than 250,000. Code 4 denotes nonmetropolitan counties with an urban population of 20,000 or more adjacent to a metropolitan area, and code 5 the same counties not adjacent.

Code 6 denotes nonmetropolitan counties with an urban population of 2,500 to 19,999 adjacent to a metropolitan area, and code 7 the same counties not adjacent. Code 8 denotes nonmetropolitan counties that are completely rural or have fewer than 2,500 urban residents and are adjacent to a metropolitan area, and code 9 the same counties not adjacent. Codes 1 to 3 were combined into a metropolitan group and codes 4 to 9 into a nonmetropolitan group.(12)

## Variables

The exposure was the Rural-Urban Continuum Code, treated first as a binary contrast (metropolitan versus nonmetropolitan) and second as an ordinal variable with nine levels. Six outcomes were derived from the American Community Survey tables. The median one-way commute time in minutes was estimated by linear interpolation of the grouped travel-time distribution in table B08303, whose categories span from less than 5 minutes to 90 minutes or more; the interpolation assumed a uniform distribution of commuters within each category.

When the median fell inside a category with lower bound L, width w and count f, it was computed as L plus the product of w and the proportion of that category needed to reach half of the total commuters. The mean commute time was estimated from the interval midpoints of 2.5, 7, 12, 17, 22, 27, 32, 37, 42, 52, 74.5 and 105 minutes, the last value assigned to the open top category, which represents an assumed upper bound of 120 minutes. Two burden measures were computed as the percentage of commuters traveling 30 minutes or more and 60 minutes or more.

Car dependence was measured as the percentage of workers who drove alone to work and the percentage who commuted by car, truck or van, both from table B08301; the percentage working from home was retained as a contrast. The percentage of households with no vehicle available was computed from table B08201. Denominators were the number of workers (B08301), the number of commuters who did not work at home (B08303) and the number of households (B08201).

## Statistical analysis

Counties with a zero denominator for a given outcome were excluded from that outcome only; no county was missing travel estimates in this dataset, and no cell was suppressed at the county level. Each outcome was summarized with the mean, standard deviation, median and interquartile range by metropolitan status. Differences between nonmetropolitan and metropolitan counties were estimated as the mean difference with a 95% confidence interval using Welch's t-test for unequal variances, and checked with the Mann-Whitney U test, which does not assume normality.

The association between the ordered continuum code and each outcome was quantified with Spearman's rank correlation. Because counties differ greatly in size, each mean difference was re-estimated with counties weighted by the analytic denominator (workers for the commute and mode outcomes, households for the zero-vehicle outcome), using effective sample sizes computed from the sum of the squared weights. Three sensitivity analyses were predefined in the protocol: population weighting; the exclusion of counties with fewer than 100 workers or households; and, within nonmetropolitan counties, the contrast between counties adjacent to a metropolitan area (codes 4, 6 and 8) and those not adjacent (codes 5, 7 and 9).

A two-sided alpha of 0.05 was used throughout, and no adjustment for multiplicity was applied because the comparisons were specified in advance. The analysis script was executed twice and produced identical results, which confirmed the reproducibility of every derived figure. Data

quality was checked before analysis: the number of retrieved counties was compared against the expected number of United States counties and county equivalents, duplicate Federal Information Processing Standards codes were searched for, every outcome denominator was required to exceed zero, and outcome values outside plausible ranges, defined as negative shares or shares above 100 percent, were searched for and none were found.

## RESULTS

### 1. County characteristics

The analysis included 3,144 counties and county equivalents, of which 1,186 were metropolitan and 1,958 nonmetropolitan (Table 1). Metropolitan counties contained 285,649,622 of the 2020 population and nonmetropolitan counties 45,799,659. The analytic denominators reached 139,393,642 workers in metropolitan counties and 19,720,452 in nonmetropolitan counties, and 110,905,060 versus 18,322,436 households.

**Table 1. County characteristics and analytic denominators by metropolitan and nonmetropolitan status, United States, 2020-2024.**

| Variable | Metropolitan (RUCC 1-3) | Nonmetropolitan (RUCC 4-9) |
|---|---|---|
| Counties, n | 1186 | 1958 |
| Population 2020, mean | 240,851 | 23,391 |
| Population 2020, total | 285,649,622 | 45,799,659 |
| Workers 16+ (ACS 2020-2024), total | 139,393,642 | 19,720,452 |
| Households, total | 110,905,060 | 18,322,436 |

Note: RUCC = Rural-Urban Continuum Code.

### 2. Commute time

The median one-way commute time was 18.6 minutes in nonmetropolitan counties and 24.1 minutes in metropolitan counties (Table 2), a difference of −5.5 minutes (95% CI, −5.9 to −5.1; $p < 0.001$). Under population weighting by workers, the gap kept its sign (−5.3 minutes; 95% CI, −6.0 to −4.6). The interquartile range ran from 14.5 to 21.9 minutes in nonmetropolitan counties and from 20.1 to 27.8 minutes in metropolitan counties, and the Mann-Whitney U test confirmed the direction of the difference ($p < 0.001$).

The mean commute time followed the same pattern, with a difference of −3.6 minutes (95% CI, −4.0 to −3.2; $p < 0.001$). The share of commuters traveling 30 minutes or more was 30.4% in nonmetropolitan and 37.7% in metropolitan counties (difference −7.3 percentage points; 95% CI, −8.2 to −6.4; $p < 0.001$). The share commuting 60 minutes or more did not differ between the two groups (difference −0.0 percentage points; 95% CI, −0.4 to 0.3; $p = 0.866$).

When excluding counties with fewer than 100 workers or households, the median difference remained −5.5 minutes (95% CI, −5.9 to −5.1) and the mean difference −3.6 minutes (95% CI, −4.0 to −3.2).

**Table 2. Commute time measures by rural-urban status, United States counties, 2020-2024.**

| Outcome | Metropolitan, mean (SD) | Nonmetropolitan, mean (SD) | Difference (95% CI) | p |
|---|---|---|---|---|
| Median one-way commute time, min | 24.1 (5.4) | 18.6 (5.8) | -5.5 (-5.9 to -5.1) | <0.001 |
| Mean one-way commute time, min | 28.4 (5.5) | 24.8 (5.9) | -3.6 (-4.0 to -3.2) | <0.001 |
| Commute of 30 min or more, % | 37.7 (12.8) | 30.4 (11.3) | -7.3 (-8.2 to -6.4) | <0.001 |
| Commute of 60 min or more, % | 8.4 (5.2) | 8.3 (4.9) | -0.0 (-0.4 to 0.3) | 0.866 |

Note: Values are unweighted county means. Difference = nonmetropolitan minus metropolitan (Welch t-test, 95% CI).

## 3. Car dependence and work from home

Workers who drove alone represented 76.8% of commuters in nonmetropolitan counties and 74.9% in metropolitan counties (Table 3), a difference of 1.9 percentage points (95% CI, 1.3 to 2.5; p < 0.001). Under population weighting, the gap widened to 9.7 percentage points (95% CI, 8.1 to 11.3). The private-vehicle share pointed in the same direction (difference 2.9 percentage points; 95% CI, 2.4 to 3.5; p < 0.001).

Work from home was 8.3% in nonmetropolitan counties and 11.8% in metropolitan counties (difference −3.5 percentage points; 95% CI, −3.9 to −3.1; p < 0.001), and the gap remained after the small-county exclusion (−3.5 percentage points; 95% CI, −3.9 to −3.1). The Spearman correlation between the continuum code and the work-from-home share was −0.32 (p < 0.001).

The drive-alone gap remained positive when small counties were excluded (1.9 percentage points). The private-vehicle gap widened similarly under weighting (10.9 percentage points; 95% CI, 9.2 to 12.7), as did the work-from-home gap under population weighting (−7.6 percentage points; 95% CI, −8.4 to −6.8).

**Table 3. Car dependence, work from home and zero-vehicle households by rural-urban status, United States counties, 2020-2024.**

| Outcome | Metropolitan, mean (SD) | Nonmetropolitan, mean (SD) | Difference (95% CI) | p |
|---|---|---|---|---|
| Drive alone to work, % | 74.9 (7.9) | 76.8 (7.9) | 1.9 (1.3 to 2.5) | <0.001 |
| Commute by private vehicle, % | 83.5 (8.3) | 86.4 (7.4) | 2.9 (2.4 to 3.5) | <0.001 |
| Work from home, % | 11.8 (5.4) | 8.3 (4.5) | -3.5 (-3.9 to -3.1) | <0.001 |
| Households with no vehicle, % | 5.9 (4.5) | 6.1 (4.3) | 0.2 (-0.1 to 0.6) | 0.141 |

Note: Values are unweighted county means. Difference = nonmetropolitan minus metropolitan (Welch t-test, 95% CI).

## 4. Zero-vehicle households

The county-level share of households with no vehicle available was similar in nonmetropolitan and metropolitan counties (6.1% versus 5.9%; difference 0.2 percentage points; 95% CI, −0.1 to 0.6; p = 0.141). Under household weighting, the pattern changed sign, with a lower zero-vehicle share in nonmetropolitan counties (−2.5 percentage points; 95% CI, −3.8 to −1.2; p < 0.001). The Spearman correlation with the continuum code was 0.00 (p = 0.836).

Excluding small counties left the unweighted difference at 0.2 percentage points (95% CI, −0.1 to 0.6).

## 5. Gradient across the rural-urban continuum

The median commute time ranged between 27.2 minutes in the largest metropolitan counties (code 1) and 15.7 minutes in the most remote nonmetropolitan counties (code 7) (Table 4); the Spearman correlation between the continuum code and the median commute was −0.46 (p < 0.001).

Driving alone ranged between 71.7% in code 1 counties and 78.8% in code 6 counties, and its correlation with the continuum code was 0.12 (p < 0.001). The correlation between the continuum code and the share commuting 30 minutes or more was −0.29 (p < 0.001). Work from home declined from 14.7% in the largest metropolitan counties to 7.6% in nonmetropolitan counties adjacent to a metropolitan area. The zero-vehicle share varied little across categories, from 6.1% to 6.6%.

**Table 4. Commute and car dependence measures across the nine Rural-Urban Continuum Code categories.**

| RUCC | Counties, n | Median commute, min | Drive alone, % | No vehicle, % | Work from home, % |
|---|---|---|---|---|---|
| 1 | 443 | 27.2 | 71.7 | 6.1 | 14.7 |
| 2 | 385 | 23.4 | 76.6 | 5.8 | 10.7 |
| 3 | 358 | 21.0 | 77.0 | 5.8 | 9.4 |
| 4 | 201 | 19.1 | 77.4 | 6.2 | 8.7 |
| 5 | 76 | 16.0 | 76.9 | 6.2 | 7.7 |
| 6 | 379 | 19.7 | 78.8 | 6.3 | 7.6 |
| 7 | 247 | 15.7 | 76.9 | 6.6 | 7.6 |
| 8 | 466 | 21.9 | 77.5 | 5.8 | 8.3 |
| 9 | 589 | 16.5 | 74.6 | 6.1 | 9.0 |

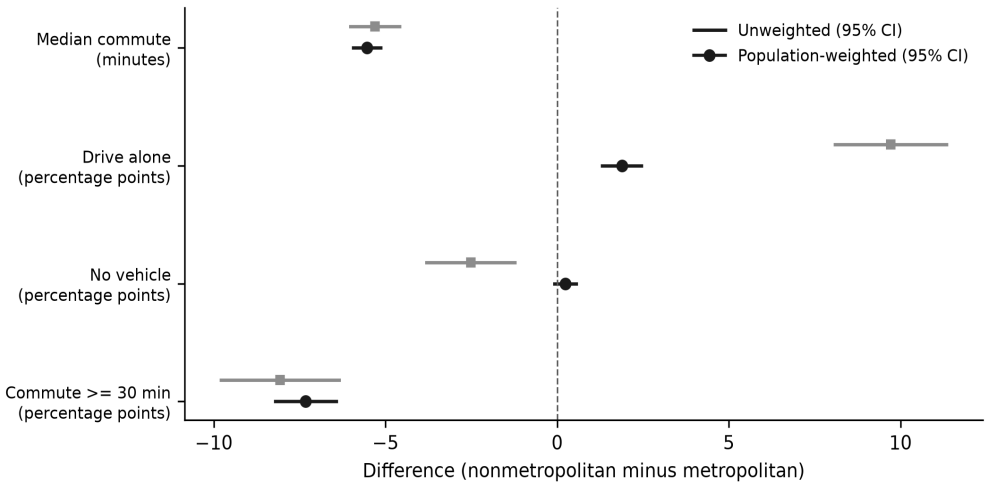
Note: Values are unweighted county means within each category. RUCC 1-3 = metropolitan; RUCC 4-9 = nonmetropolitan.

## 6. Sensitivity analyses

The population-weighted estimates confirmed the direction of every primary result except the zero-vehicle share (Figure 1). The population-weighted and unweighted differences overlapped for the median commute, the drive-alone share and the share commuting 30 minutes or more. The population-weighted share commuting 30 minutes or more differed by −8.1 percentage points (95% CI, −9.8 to −6.3).

Within nonmetropolitan counties, those adjacent to a metropolitan area had longer commutes than those not adjacent (20.6 versus 16.2 minutes; $p < 0.001$) and higher drive-alone shares (78.0% versus 75.4%; $p < 0.001$). The zero-vehicle share did not differ between the two groups (difference 0.2 percentage points; $p = 0.412$).

**Figure 1. Population-weighted versus unweighted rural-urban differences for four primary outcomes.**




Note: Circles and squares are point estimates; bars are 95% confidence intervals. Nonmetropolitan minus metropolitan.

## DISCUSSION

In a complete county-level assessment of the United States, nonmetropolitan counties commuted shorter distances than metropolitan counties while depending more on private cars, and the county-level zero-vehicle household rate did not distinguish rural from urban counties when each county was counted equally. These results place the rural transport problem in a specific light: the burden of rural America is not primarily long commutes but automobile dependence without alternatives.(2)

The shorter rural commute runs against the image of the rural long-distance commuter but is consistent with earlier commuting geography. Studies of the rural-urban hierarchy showed that commuting ties rural workers to nearby urban centres rather than extending their trips uniformly, and that the highest commuting intensities occur around metropolitan cores.(7,8)

The longest average commutes in this study appeared in the largest metropolitan counties, where job-housing imbalance and congestion lengthen travel.(9)

Survey-based work on low-income workers in the United States likewise locates the heaviest commuting burden in metropolitan areas.(10)

The absence of a rural-urban gap in very long commutes of 60 minutes or more is informative: extreme commuting exists in both settings, driven by congestion in metropolitan areas and by long distances to regional centres in remote rural counties. Longer commutes carry documented welfare costs, including lower satisfaction and diminished well-being, which this pattern attaches mainly to large metropolitan counties.(14,15)

The mechanisms behind this pattern operate on both sides of the continuum. Rural labour markets are local: residents of small towns and the surrounding countryside often work within the same county, in agriculture, resource extraction, manufacturing or public services, so their commutes are short even when the destination is reached exclusively by car.(8)

Metropolitan labour markets, by contrast, integrate employment across a wide region, and the separation of affordable housing from job-rich cores lengthens travel even for workers who never enter the congested centre.(9)

The flat rural-urban gap in commutes of 60 minutes or more is the signature of these two mechanisms operating simultaneously: congestion stretches trips in large metros, while distance to a regional centre stretches the trips of the minority of rural workers who commute out of their county.(7)

These cross-sectional averages also embed a specific temporal window. The 2020 to 2024 period straddles the COVID-19 pandemic, which temporarily collapsed commuting, shifted a large share of metropolitan knowledge work to the home and only partially recovered by 2024.(16,17)

Because the rural-urban gap in work from home widened in this window, part of the observed difference reflects the uneven geography of pandemic-era remote work rather than a stable feature of rural labour markets.(18,19)

The stability of the commute-time and car-dependence results across sensitivity analyses does not remove this temporal caveat, and repeated measurement with the next five-year release will show whether the work-from-home gradient persists.

The higher drive-alone and private-vehicle shares in nonmetropolitan counties agree with a broad literature on rural car dependency in Ireland, the United Kingdom, China and the United States.(2,3,5,20)

Automobile dependence is a structural feature of rural settlement: low density makes public transport economically fragile and car ownership a near precondition of participation in work and services.(4,6,21)

Within rural areas, the gradient between adjacent and non-adjacent counties reinforces this reading; counties that function as residential extensions of metropolitan labour markets showed both longer commutes and higher drive-alone shares than the most remote counties, where shorter local trips predominate.(7,22)

Comparative work on car ownership in rural towns and on the spatial limits of car-dependence models reaches the same conclusion, namely that rurality itself, rather than income or preference alone, sustains automobile reliance.(23-25)

Non-car modes cannot close the rural gap in the short term. Walking and cycling serve very short trips, and in low-density settlements the distances to work, school and services exceed comfortable active-travel ranges for most residents.(26)

Demand-responsive and shared services have repeatedly been proposed as rural solutions, but their economics remain fragile at rural densities, and their users still depend on the car for the last mile or for trips the services do not cover.(27,28)

These findings therefore argue for realism: policy should treat the car as part of the rural mobility system and direct effort toward making it affordable, shared and gradually less dominant, rather than assuming that mode shift can proceed as it does in cities.(4)

The lower work-from-home share in nonmetropolitan counties is consistent with the occupational structure of rural labour markets and with post-pandemic telework studies that find remote work concentrated in metropolitan knowledge sectors.(16,17,29)

Telework intensity, and not only its prevalence, follows the same urban gradient, and its uneven geography persisted after the acute phase of the pandemic.(18,19,30)For rural residents, the

smaller remote-work share means fewer opportunities to substitute travel with connectivity, which compounds their dependence on the automobile for daily participation.(31,32)

Expanding remote work is unlikely, by itself, to reduce rural car dependence, because the occupations that can be performed remotely are underrepresented in rural economies and because remote workers still rely on the car for non-work travel.(29,32)

The null unweighted difference in zero-vehicle households, together with its reversal under household weighting, is the most informative result. Zero-vehicle households cluster in large central cities with dense transit networks, so a household-weighted national mean is dominated by metropolitan counties.(33,34)

In rural counties, carlessness is less common on average but more likely to be involuntary and linked to poverty than to the availability of alternatives.(3,35,36)

The two settings therefore present different forms of transport disadvantage that a binary rural-urban contrast conceals. This distinction bears directly on measurement: studies of car ownership burden that weight households, and studies that weight counties, can report opposite signs for the same construct, as occurred here.(5,37)

Taken together, the findings reframe the prevailing account of rural transport disadvantage. The disadvantage of rural counties is not that residents travel too far but that they have no practical alternative to the private car, so households without a vehicle, older adults who no longer drive and people with disabilities are exposed to acute mobility poverty.(3,31)

The disadvantage of large metropolitan counties is the opposite: alternatives exist but congestion and housing constraints inflate travel time, and the longest commutes fall on the workers least able to pay for them.(9,10)

A rural-urban contrast expressed only through average commute time would miss both problems, which is why the zero-vehicle and car-dependence measures are indispensable companions to the commute-time result.

The gradient analysis sharpens the interpretation further. Commute time declined along the continuum from the largest metropolitan counties to the most remote rural counties, while drive-alone shares remained above three quarters in every nonmetropolitan category and work from home fell by roughly half between the largest metropolitan counties and the smallest nonmetropolitan counties.

The zero-vehicle share, by contrast, was flat across the nine categories, which confirms that vehicle ownership is distributed differently from the commute and mode variables that distinguish rural from urban counties. The estimates were stable across population weighting and the exclusion of small counties, and every difference kept its sign in those specifications except the zero-vehicle share, as described above.

The comparison with studies that use different designs reinforces confidence in the findings. Household-level surveys capture individual commute decisions but thin out in rural areas, whereas the present county-level design trades individual detail for complete coverage and therefore avoids the rural under-sampling that weakens survey-based contrasts.(12)

Models of car dependence built from individual or household data reach similar conclusions about the structural role of rurality.(24,25) The direction of the results held under population weighting and county-size exclusions, which indicates that the findings are not an artefact of the many small rural counties that dominate the unweighted sample.

The analysis also offers a methodological lesson for county-level transport equity research. Reporting a single rural-urban difference for a construct such as vehicle ownership can hide the dependence of the sign on the weighting scheme, as the reversal of the zero-vehicle result shows.

Researchers comparing counties should therefore report both unweighted and population-weighted estimates, state the analytic denominator for each outcome, and accompany binary comparisons with the ordered continuum when the classification allows it.(12)These conventions cost little and prevent the sign of a headline difference from becoming an artefact of the weighting choice.

The choice of the Rural-Urban Continuum Codes also warrants scrutiny alongside alternative classifications. The Rural-Urban Commuting Area codes measure rurality through commuting flows themselves, whereas the continuum codes rely on population size and adjacency, and the two can disagree for counties with strong commuting ties to a core.(12)

Because commuting is one of the outcomes studied here, a classification built from population size and adjacency avoids circularity: it does not define rurality by the very travel behaviour being measured. This independence supports the present choice, and the contrast between adjacent and non-adjacent nonmetropolitan counties reproduced the same qualitative conclusions.

The main strengths of this study are the complete coverage of United States counties, the use

of a standardized nine-category rural-urban classification, the reproducibility of the estimates from public data and the explicit sensitivity to weighting and county size. The main limitations follow from the design. The ecological unit is the county, so the associations describe places rather than individuals and cannot be transferred to residents without committing the ecological fallacy, and the cross-sectional design cannot establish the direction of any causal relation between rurality and travel behaviour.(12)

The cross-sectional period 2020 to 2024 obscures the pandemic-era disruption of commuting and its partial recovery.(16)

The Rural-Urban Continuum Codes are based on the 2020 census while the travel estimates span 2020 to 2024, a small temporal mismatch. Margins of error from the American Community Survey were not propagated into the county-level means, although five-year county estimates are large enough that suppression was absent.

The grouped travel-time distribution required midpoint assumptions for the mean commute, and the median was used as the primary outcome to limit that assumption. County-level income, age structure and industry mix were not adjusted for, so part of the rural-urban difference may reflect these compositional factors rather than rurality itself.

Each limitation suggests a concrete extension. Multilevel individual data would address the ecological gap; annual series would track post-pandemic recovery; and a margin-of-error-weighted mean would refine the county estimates. For policy, these results imply that rural transport policy should prioritize access alternatives and vehicle affordability over commute-time relief, whereas metropolitan policy continues to confront long commutes. In rural areas, subsidized demand-responsive services, intercity connections and support for vehicle access among low-income households address the documented dependence, and public acceptability of the measures that reduce car reliance depends on how the dependence itself is framed.(2,38,39)

Rural transport interventions, from autonomous shuttles to shared mobility, remain plausible but unproven complements to the private car, and their evaluation should be framed against the baseline of dependence documented here.(26-28)

Measuring rurality along the full continuum, rather than as a binary, should become standard in county-level transport equity analysis, and repeating this assessment with each new five-year release of the American Community Survey would turn a cross-sectional snapshot into a monitor of rural mobility disadvantage over time.(12) The county is also the administrative scale at which many United States transport and housing programs operate, so these results translate directly into the geography of funding allocation and planning.

## CONCLUSIONS

Commute time, car dependence and zero-vehicle household rates were compared between rural and urban counties of the United States, and their variation across the rural-urban continuum was quantified. Nonmetropolitan counties showed shorter commutes and greater reliance on private cars, while county-level zero-vehicle household rates did not differ between the two groups.

The differences in commuting and car dependence remained stable under population weighting and the exclusion of small counties, whereas the zero-vehicle result reversed once households were weighted. Across the continuum, commute time fell from the largest metropolitan counties to the most remote rural counties while drive-alone shares remained high in every nonmetropolitan category, and work from home declined from metropolitan cores toward the rural periphery. These contrasts imply that the two policy agendas are complementary rather than competing: metropolitan areas need shorter and faster commutes, while rural areas need alternatives to the private car and support for the households that cannot afford one.

## REFERENCES

1. U.S. Census Bureau. American Community Survey 2024 5-Year Estimates: Tables B08301, B08303 and B08201 [Internet]. 2024. Available from: https://www.census.gov/programs-surveys/acs
2. Carroll P, Benevenuto R, Caulfield B. Identifying hotspots of transport disadvantage and car dependency in rural Ireland. Transport Policy. 2021;101:46-56. doi: 10.1016/j.tranpol.2020.11.004
3. Christie SML, Fone DL. Does car ownership reflect socio-economic disadvantage in rural areas? A cross-sectional geographical study in Wales, UK. Public Health. 2003;117(2):112-116. doi: 10.1016/s0033-3506(02)00027-6
4. Newman P, Kenworthy J. Costs of Automobile Dependence: Global Survey of Cities. Transportation Research Record: Journal of the Transportation Research Board. 1999;1670(1):17-26. doi: 10.3141/1670-04
5. Walks A. Driving the poor into debt? Automobile loans, transport disadvantage, and automobile dependence. Transport Policy. 2018;65:137-149. doi: 10.1016/j.tranpol.2017.01.001
6. Zhang Y, Xu D. The bus is arriving: Population growth and public transportation ridership in rural America. Journal of Rural Studies. 2022;95:467-474. doi: 10.1016/j.jrurstud.2022.09.018
7. Morrill R, Cromartie J, Hart G. METROPOLITAN, URBAN, AND RURAL COMMUTING AREAS: TOWARD A BETTER DEPICTION OF THE UNITED STATES SETTLEMENT SYSTEM. Urban Geography. 1999;20(8):727-748. doi: 10.2747/0272-3638.20.8.727
8. Fuguitt GV. Commuting and the rural-urban hierarchy. Journal of Rural Studies. 1991;7(4):459-466. doi: 10.1016/0743-0167(91)90009-h
9. Sultana S. Job/Housing Imbalance and Commuting Time in the Atlanta Metropolitan Area: Exploration of Causes of Longer Commuting Time. Urban Geography. 2002;23(8):728-749. doi: 10.2747/0272-3638.23.8.728
10. Blumenberg E, King H. Low-Income Workers, Residential Location, and the Changing Commute in the United States. built environ. 2019;45(4):563-581. doi: 10.2148/benv.45.4.563
11. Chakrabarti S, Verma S, Verma M. Gender gap in commute time allocation: analyzing the effects of major life events and urban–rural differences using India's time use survey. Transportation. 2026. doi: 10.1007/s11116-026-10779-x
12. Hankes MJ, Judd SE, Jones R. Bridging the rural-urban divide: A commentary on Rural-Urban Commuting Area codes. The Journal of Rural Health. 2025;41(1):e12911. doi: 10.1111/jrh.12911
13. USDA Economic Research Service. Rural-Urban Continuum Codes 2023 [Internet]. 2024. Available from: https://www.ers.usda.gov/data-products/rural-urban-continuum-codes/
14. Morris EA, Zhou Y. Are long commutes short on benefits? Commute duration and various manifestations of well-being. Travel Behaviour and Society. 2018;11:101-110. doi: 10.1016/j.tbs.2018.02.001
15. De Vos J, Le HTK, Kroesen M. Does commute duration attenuate the effect of travel mode choice on commute satisfaction?. Travel Behaviour and Society. 2022;28:13-21. doi: 10.1016/j.tbs.2022.02.004
16. Shi H, Goulias KG. Long-term effects of COVID-19 on time allocation, travel behavior, and shopping habits in the United States. Journal of Transport & Health. 2024;34:101730. doi: 10.1016/j.jth.2023.101730
17. Stiles J, Smart MJ. Working at home and elsewhere: daily work location, telework, and travel among United States knowledge workers. Transportation. 2021;48(5):2461-2491. doi: 10.1007/s11116-020-10136-6
18. Zhou L, Dai J, Sun W, Yang T. The new geography of work and mobility: Behavioural, spatial and sectoral dynamics of telework during and after COVID-19. Travel Behaviour and Society. 2026;44:101253. doi: 10.1016/j.tbs.2026.101253
19. Chen P, Ling C. No remote, hybrid remote, and full remote: Additional insights from telework intensity. Transportation Research Part D: Transport and Environment. 2026;159:105532. doi: 10.1016/j.trd.2026.105532
20. Zhao P, Yu Z. Investigating mobility in rural areas of China: Features, equity, and factors. Transport Policy. 2020;94:66-77. doi: 10.1016/j.tranpol.2020.05.008
21. Timmons S, Shier AJ, Lunn PD. Public transport availability, delayed learning to drive and later life car dependence. Transportation Research Part D: Transport and Environment. 2026;160:105551. doi: 10.1016/j.trd.2026.105551
22. Yuan C, Yao Z, Ding Y, Shang M. Breaking spatial barriers: how urban-rural transportation integration reshapes rural entrepreneurial entry. Journal of Rural Studies. 2026;128:104368. doi: 10.1016/j.jrurstud.2026.104368
23. Yu Z, Zhao P. The factors in residents' mobility in rural towns of China: Car ownership, road infrastructure and public transport services. Journal of Transport Geography. 2021;91:102950. doi: 10.1016/j.jtrangeo.2021.102950
24. Sierra Muñoz J, Duboz L, Ciuffo B, Pucci P. Can spatial indicators fully explain car dependence? Evidence from Lombardy (Italy). Journal of Urban Mobility. 2026;9:100197. doi: 10.1016/j.urbmob.2026.100197
25. Yadav A, Jin T, Barros J, Koomen E, Bacao F. Modelling car dependence: Pathways to sustainable urban mobility. Cities. 2026;173:106980. doi: 10.1016/j.cities.2026.106980
26. Huth C, Meinherz FX. Proximity and the countryside: Assessing the potential for proximity-centered accessibility by bicycle in rural Germany. Journal of Urban Mobility. 2026;10:100298. doi: 10.1016/j.urbmob.2026.100298
27. Söderberg A, Smith G. Shared mobility and coworking in rural areas: A vision detached from reality?. Journal of Transport Geography. 2026;132:104610. doi: 10.1016/j.jtrangeo.2026.104610
28. Ceccato R, Dianin A, Gastaldi M. Implications of autonomous vehicles for accessibility and mobility patterns in rural settings. Transport Policy. 2026;189:104435. doi: 10.1016/j.tranpol.2026.104435
29. Núñez Pugarín V, Loza-Herrera W, Pugarín P. Telework and automobile dependence in U.S. metropolitan areas: Commute mode and daily vehicle travel evidence from the 2022 NextGen NHTS. Transport Economics and Management. 2026;4:299-318. doi: 10.1016/j.team.2026.09.003
30. Al-Akioui A, Monzon A, Pfaffenbichler P. Exploring the association between teleworking, mobility, and residential patterns: The role of teleworking intensity and socioeconomic characteristics. Journal of Urban Mobility. 2026;10:100285. doi: 10.1016/j.urbmob.2026.100285

31. Kandt J, Deng H, Porter MM. Independent ageing, climate risks and automobile dependence in the Canadian prairies: Evidence from the Canadian Longitudinal Study on Aging. Travel Behaviour and Society. 2026;43:101213. doi: 10.1016/j.tbs.2025.101213
32. Fridén Syrjäpalo L, Ekman Ladru D. Squeezing the Distance. Time-Spatial organization and negotiation of families' everyday mobility in remote rural settings in the Swedish north. Journal of Rural Studies. 2026;124:104109. doi: 10.1016/j.jrurstud.2026.104109
33. De Gruyter C, Truong LT, de Jong G, Foster S. Determinants of zero-car and car-owning apartment households. Transportation. 2025;52(4):1593-1620. doi: 10.1007/s11116-024-10467-8
34. Delbosc A, Currie G. Choice and disadvantage in low-car ownership households. Transport Policy. 2012;23:8-14. doi: 10.1016/j.tranpol.2012.06.006
35. Paul J. Beyond the Company Carpool: Disadvantage and Informal Automobile Sharing Within and Between U.S. Households. Transportation Research Record: Journal of the Transportation Research Board. 2024;2678(12):1271-1288. doi: 10.1177/03611981241250338
36. Molloy Q, Garrick N, Atkinson-Palombo C. Black Households Are More Burdened by Vehicle Ownership than White Households. Transportation Research Record: Journal of the Transportation Research Board. 2024;2678(10):163-173. doi: 10.1177/03611981241231968
37. Maharjan S, Janatabadi F, Ermagun A. Spatial Inequity of Transit and Automobile Access Gap across America for Underserved Population. Transportation Research Record: Journal of the Transportation Research Board. 2024;2678(1):674-690. doi: 10.1177/03611981231171914
38. Klein NJ, Basu R, Smart MJ. In the driver's seat: Pathways to automobile ownership for lower-income households in the United States. Transportation Research Interdisciplinary Perspectives. 2023;18:100787. doi: 10.1016/j.trip.2023.100787
39. Maciejewska M, Roig-Costa O, Tassinari F, Marquet O. Not just self-interest: How car dependence shapes the acceptability of street interventions in Barcelona. Journal of Urban Mobility. 2026;10:100270. doi: 10.1016/j.urbmob.2026.100270

## FUNDING

No financing

## CONFLICT OF INTEREST

None

## AUTHORSHIP CONTRIBUTIONS

Drafting – original draft: Edixon Chacón Guerrero.
Writing–review and editing: Edixon Chacón Guerrero.