
Housing plus transportation affordability indices: uses, opportunities, and challenges

OECD round-table on income inequality, social inclusion,
and mobility (Paris, 2016 April)

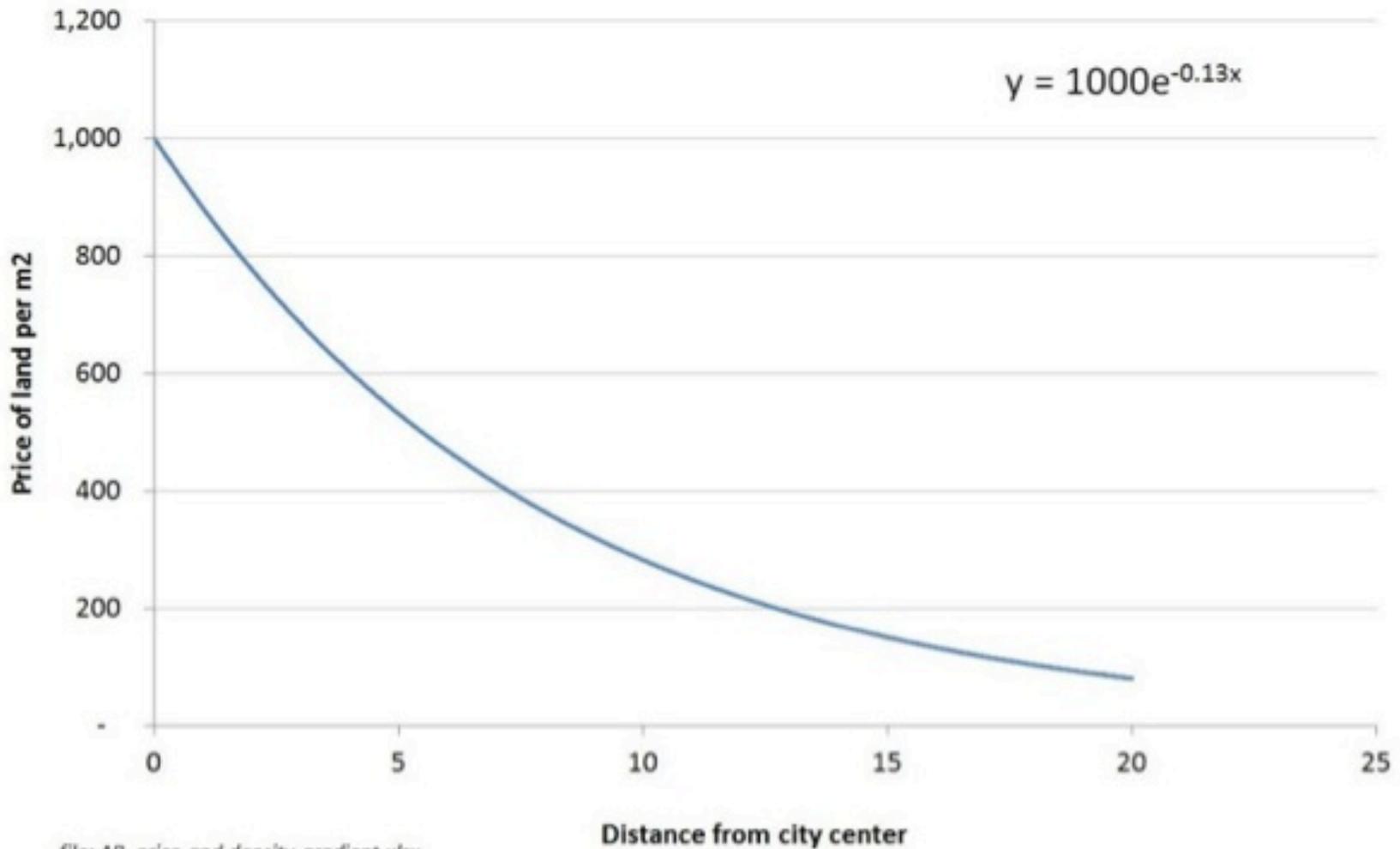
Erick Guerra
& Mariel Kirschen
University of Pennsylvania



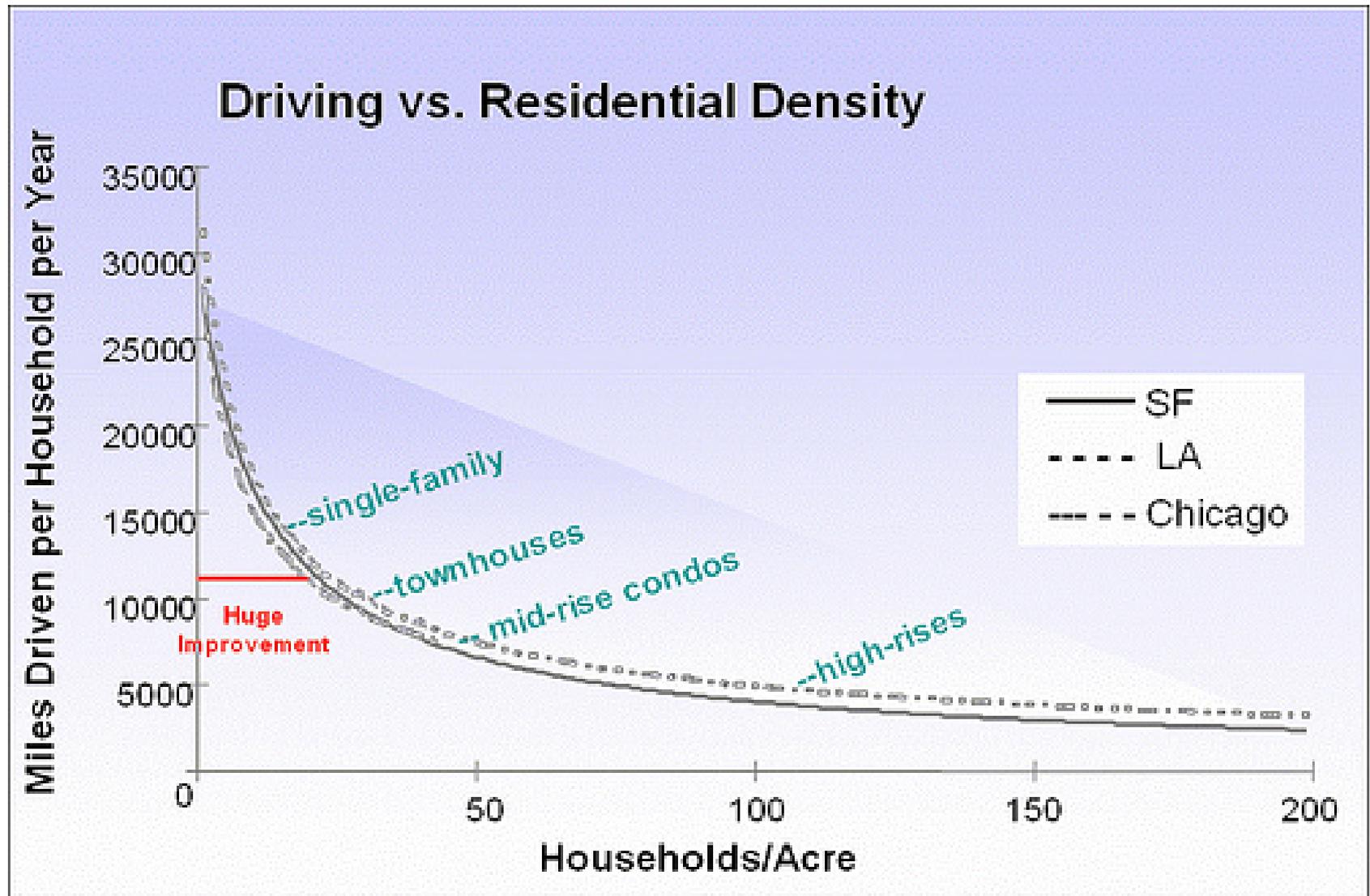
Presentation Outline

1. The relationship between transportation and housing costs
2. The H+T Adorability Index: estimation and policy uses
3. H+T challenges and critiques
4. Application to Mexico City
5. Transferability to other OECD countries

Housing values and distance to CBD



VMT and distance to CBD



The H+T Affordability Index

- Housing affordability: < 30% of income spent on housing
- H+T affordability: <45% of income spent on housing and transportation



[H+T Index](#)

[H+T Fact Sheets](#)

[Total Driving Costs](#)

[Comparison Maps](#)

[Data](#)

[About](#)



H+T[®] Index

The H+T Affordability Index

H+T® Two Views of Affordability

Tour | [+] Share Map

philadelphia pa



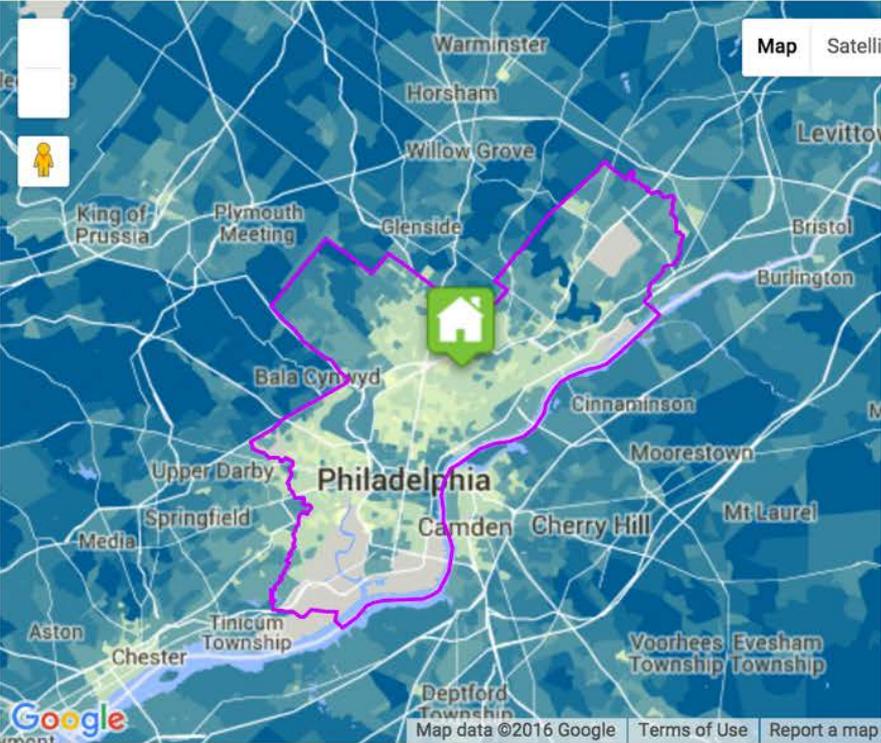
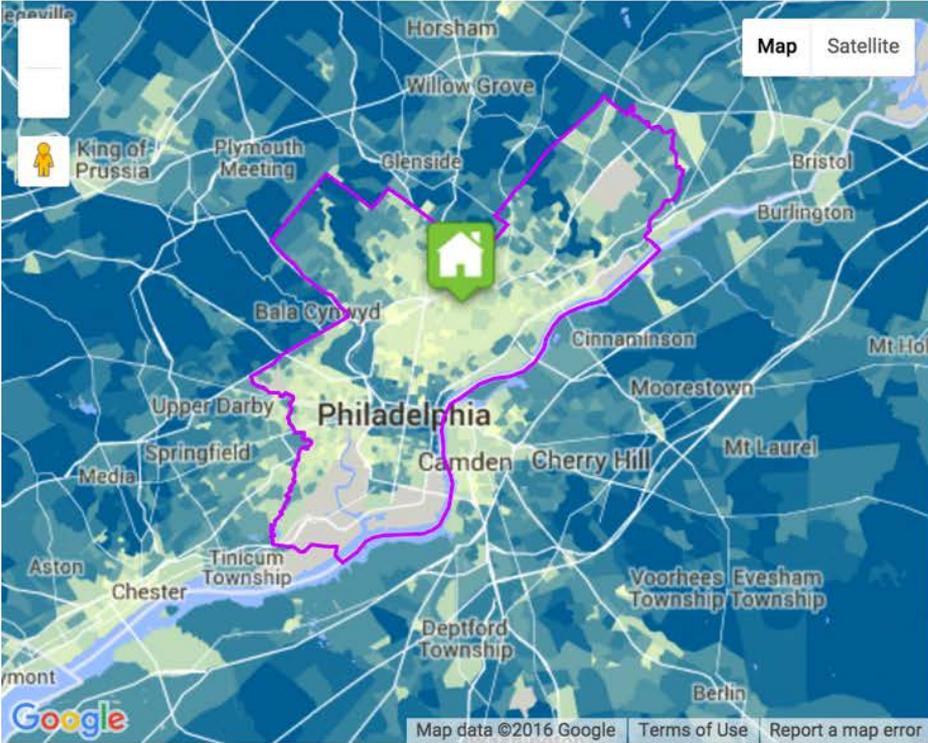
Municipality: Philadelphia, PA

You may enter an address, city, county or zip

Regional Typical Regional Moderate National Typical

Map Detail: Low (2-Color) High (8-Color)

Income: \$49,538 Commuters: 1.16 workers Household Size: 2.62 people
Block Groups: 1,336 Households: 580,017



Housing Costs % Income **27%**
Range: 5 - 93

Fact Sheet

< 16% 16-24% 24-30% 30-36% 36-44% 44-52% 52-58% 58%+

Housing + Transportation Costs % Income **43%**
Range: 21 - 119

Fact Sheet

< 24% 24-36% 36-45% 45-54% 54-66% 66-78% 78-87% 87%+

The H+T Affordability Index

H+T® Two Views of Affordability

New Tab

washington dc



You may enter an address, city, county or zip

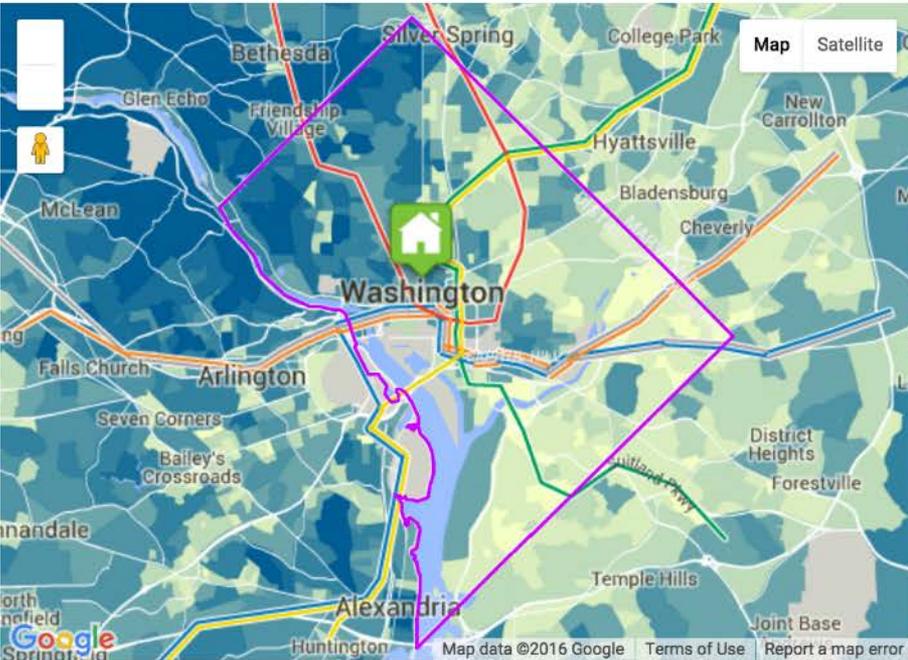
Map Detail: Low (2-Color) High (8-Color)

Municipality: Washington, DC

Regional Typical Regional Moderate National Typical

Income: \$72,432 Commuters: 1.35 workers Household Size: 2.70 people
Block Groups: 450 Households: 263,649

Tour | [+] Share Map

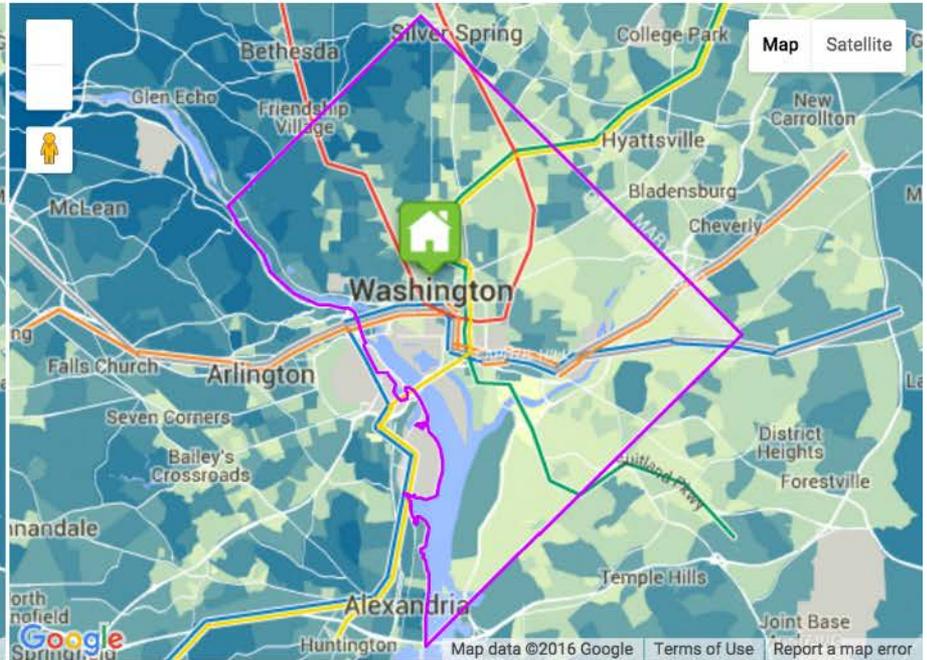


Housing Costs % Income **29%**

Range: 5 - 66

< 16% 16-24% 24-30% 30-36% 36-44% 44-52% 52-58% 58%+

Fact Sheet



Housing + Transportation Costs % Income **42%**

Range: 14 - 85

< 24% 24-36% 36-45% 45-54% 54-66% 66-78% 78-87% 87%+

Fact Sheet

The H+T Affordability Index

H+T® Two Views of Affordability

st louis, mo

You may enter an address, city, county or zip

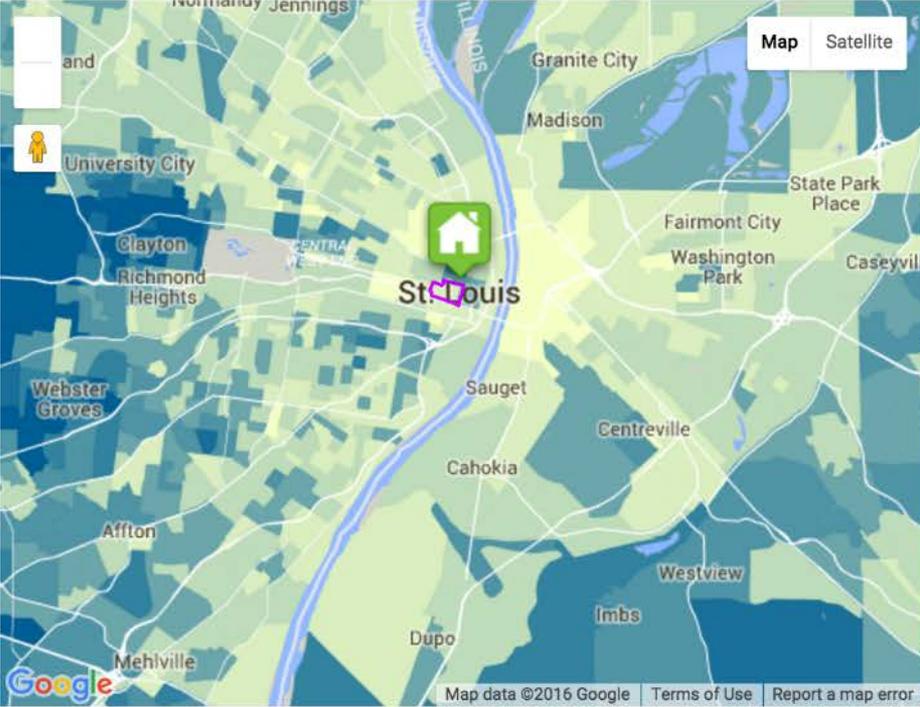
Map Detail: Low (2-Color) High (8-Color)

Block Group: 295101255002

Regional Typical Regional Moderate National Typical

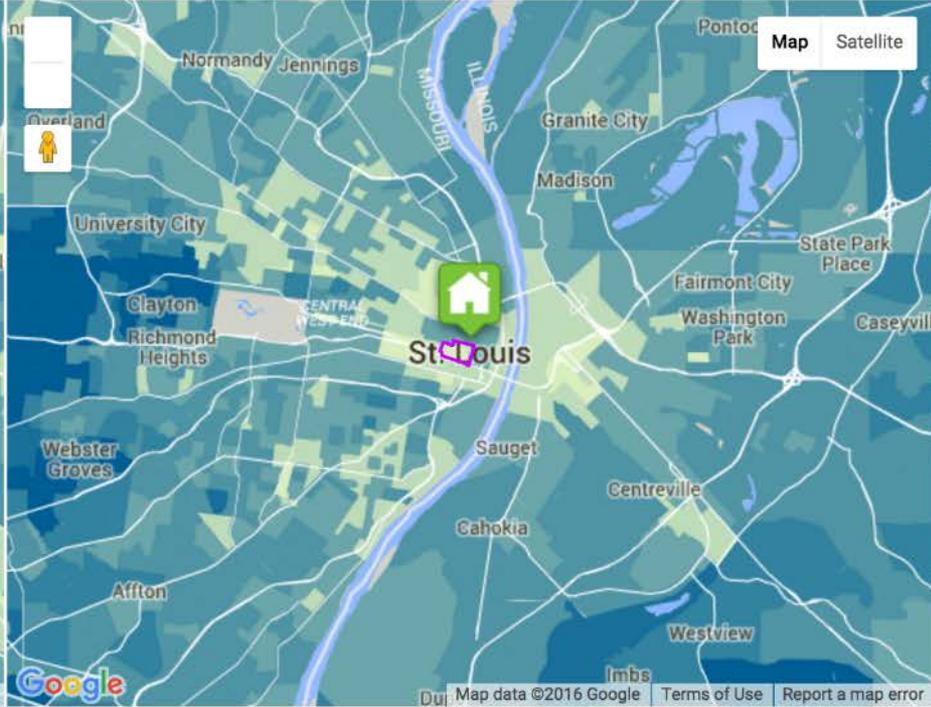
Income: \$43,570 Commuters: 1.12 workers Household Size: 2.48 people
Block Groups: 1 Households: 514

Tour | [+] Share Map



Housing Costs % Income 17%

< 16% 16-24% 24-30% 30-36% 36-44% 44-52% 52-58% 58%+



Housing + Transportation Costs % Income 35%

< 24% 24-36% 36-45% 45-54% 54-66% 66-78% 78-87% 87%+

H+T Calculation

The H+T Affordability Index: calculation

$$\text{Index} = \frac{\text{Housing Costs} + \text{Transportation Costs}}{\text{Income}}$$

The H+T Affordability Index: calculation

$$\text{Index} = \frac{\text{Housing Costs} + \text{Transportation Costs}}{\text{Income}}$$

Household Transportation Costs

$$[C_{AO} * F_{AO}(X)] + [C_{AU} * F_{AU}(X)] + [C_{TU} * F_{TU}(X)]$$

Where:

C is the cost factor (i.e. dollars per mile)

F is a function of the independent variables (F_{AO} is auto ownership, F_{AU} is auto use, F_{TU} is transit use)

The H+T Affordability Index: overview

Neighborhood Characteristics

Gross Density

Regional Household Intensity

Fraction of Single-Family Detached Housing

Block Density

Employment Access Index

Employment Mix Index

Transit Connectivity Index

Transit Access Shed

Transit Access Shed Jobs

Average Available Transit Trips per Week

Household Characteristics

Median Household Income

Average Commuters per Household

Average Household Size



Auto Ownership
+
Auto Usage
+
Public Transit Usage



**TOTAL
TRANSPORTATION
COSTS**

The H+T Affordability Index: car ownership costs

1. Estimate car ownership in neighborhood (multivariate OLS)

| Prediction | Source | Predictors |
|----------------|----------|--|
| Auto Ownership | 2013 ACS | Fraction of single family detached housing |
| | | Commuters per household |
| | | Transit connectivity index |
| | | Median household income |
| | | Gross household density |
| | | Employment Mix |
| | | Household Size |
| | | Regional Household Intensity |
| | | Block Density |
| | | Employment Gravity |

2. Estimate cost of car ownership for five income groups. Average cost of car ownership by income group from 2005-2010 Consumer Expenditure Surveys.
3. Multiply 1 and 2 for a typical regional household

The H+T Affordability Index: vehicle travel costs

1. Estimate vehicle travel (multivariate OLS using IL odometer data)

| Prediction | Source | Predictors |
|-----------------------|--|--|
| Auto Use (VMT) | Odometer readings in IL from 2010-2012 | Fraction of Single family detached housing |
| | | Average Available Transit Trips per Week |
| | | Commuters/Household |
| | | Gross Household Density |
| | | Regional Household Intensity |
| | | Transit connectivity index |
| | | Median household income |
| | | Average Household Size |
| | | Employment Access Index |
| | | Transit Access Shed |

2. Estimate cost of vehicle use for five income groups. Average cost by income group from 2005-2010 Consumer Expenditure Surveys.
3. Multiply 1 and 2 for a typical regional household

The H+T Affordability Index: transit costs

1. Estimate percent commuting to work by transit (multivariate regression)

| Prediction | Source | Predictors |
|-------------|---|--|
| Transit Use | 2013 ACS (% public transportation commuters) | Regional Household Intensity |
| | | Transit Connectivity |
| | | Employment Access Index |
| | | Employment Mix Index |
| | | Fraction of single family detached housing |
| | | Transit Access Shed |
| | | Transit Access Shed Jobs |
| | | Median Household Income |
| | | Average Available Transit Trips per Week |
| | | Average Household Size |

2. Match fare revenue data from National Transit Database to block groups based on GTFS station/stop data.
3. Divide total fare revenues from a block group by households in block group

H+T and Public Policy

Planners

- Chicago - Metropolitan Planning Council (MPC) used H+T index data in a “corridor selection analysis” to determine potential BRT locations
- Chicago Metropolitan Agency for Planning (CMAP) used suggested H+T index standard as their livability measure in their GO TO 2040 comprehensive regional plan.
- Ohio –Living Cities sponsored the CNT and the Ohio Governor’s office to use the tool for suggestions for state urban revitalization strategies to reduce cost of living in Cincinnati, Cleveland, and Columbus.
- Washington, DC – Office of Planning worked with CNT on a custom H+T index that integrated market-rate housing costs and local land-use and transit network data.

Source: CNT website

Housing professionals

- Minneapolis-St.Paul; Washington, DC; Boston; San Francisco Bay Area – Partnered with the Urban Land Institute (ULI), CNT developed customized calculators that could both compare neighborhood costs and direct transportation choices.
- Santa Fe, NM – Local housing nonprofit uses a tailored Index platform to inform prospective homeowners about location efficiency and how to manage transportation costs in order to save for homeownership.
- San Francisco, CA – The Metropolitan Transportation Commission (MTC) gave credit to the Index for the establishment of the Bay Area Transit Oriented Affordable Housing Fund.
- Center for Housing Policy – Research with CNT concerning struggles of moderate-income households to tackle hidden factors that threaten affordability of housing and transportation.

Source: CNT website

Policy Makers

- State of Illinois – The 45% affordability measure adopted into law with bipartisan support to be used by five government agencies for both financing and siting decisions.
- El Paso, TX – City Council adopted 50% H+T affordability standard for City funding and policy decisions.
- Low Income Housing Tax Credit Allocations

Policy Makers

- Department of Housing and Urban Development (HUD) - Sustainable Communities Initiative grants to support sustainable development projects.

The image is a screenshot of the Sustainable Communities website. At the top, there is a blue header with the text "partnership for Sustainable Communities" and "an interagency partnership HUD • DOT • EPA". To the right of the header are three circular logos: the Department of Housing and Urban Development, the Department of Transportation, and the United States Environmental Protection Agency. Below the header is a dark blue navigation bar with the following links: "> Home", "> About Us", "> In Your Community", and "> Resources and Tools". The main content area features a large illustration of a city street with a tram, a bus stop, and a cafe. In the bottom left corner of the illustration, there is a text box with the following text: "2014 TIGER Awards Announced", "US DOT announces 71 TIGER 2014 awards! The United States Department of Transportation distributed nearly \$600 million for 72 transportation projects in 46 states and the District of Columbia from its TIGER (Transportation Investment Generating Economic Recovery) 2014 program.", and "Read more". In the bottom right corner of the illustration, there are three small black buttons with white text: "1", "2", and "3". At the very bottom right of the screenshot, there are three more buttons: a pause button, "Previous", and "Next".

partnership for
Sustainable Communities
an interagency partnership HUD • DOT • EPA

> Home > About Us > In Your Community > Resources and Tools

2014 TIGER Awards Announced

US DOT announces 71 TIGER 2014 awards! The United States Department of Transportation distributed nearly \$600 million for 72 transportation projects in 46 states and the District of Columbia from its TIGER (Transportation Investment Generating Economic Recovery) 2014 program.

Read more

1 2 3

|| Previous Next

The H+T Affordability Index: shaping affordability narratives

Moderate-Income Housing and Transportation Burden

| MUNICIPALITY | % Housing Rank | % Housing + Transportation Rank | Change in Rank After Adding Transportation | | CMSA | % Housing Rank | % Housing + Transportation Rank | Change in Rank After Adding Transportation |
|---------------|----------------|---------------------------------|--|--|---------------|----------------|---------------------------------|--|
| Washington | 8 | 1 | -7 | | Washington | 4 | 1 | -3 |
| Baltimore | 1 | 2 | 1 | | Minneapolis | 1 | 2 | 1 |
| Philadelphia | 6 | 3 | -3 | | Baltimore | 9 | 3 | -6 |
| Boston | 12 | 4 | -8 | | Boston | 16 | 4 | -12 |
| Minneapolis | 7 | 5 | -2 | | Denver | 6 | 5 | -1 |
| NYC | 17 | 6 | -11 | | Seattle | 13 | 6 | -7 |
| St. Louis | 3 | 7 | 4 | | Philadelphia | 15 | 7 | -8 |
| Cincinnati | 2 | 8 | 6 | | San Francisco | 18 | 8 | -10 |
| Pittsburgh | 5 | 9 | 4 | | Cincinnati | 2 | 9 | 7 |
| Detroit | 4 | 10 | 6 | | Pittsburgh | 3 | 10 | 7 |
| Denver | 10 | 11 | 1 | | St. Louis | 5 | 11 | 6 |
| San Francisco | 20 | 12 | -8 | | Dallas | 7 | 12 | 5 |
| Chicago | 15 | 13 | -2 | | Detroit | 12 | 13 | 1 |
| Dallas | 11 | 14 | 3 | | NYC | 22 | 14 | -8 |
| Seattle | 16 | 15 | -1 | | Houston | 8 | 15 | 7 |
| Houston | 9 | 16 | 7 | | Chicago | 17 | 16 | -1 |
| Sacramento | 13 | 17 | 4 | | Portland | 14 | 17 | 3 |
| Portland | 18 | 18 | 0 | | Atlanta | 10 | 18 | 8 |
| Atlanta | 19 | 19 | 0 | | Phoenix | 11 | 19 | 8 |
| Phoenix | 14 | 20 | 6 | | Sacramento | 19 | 20 | 1 |
| Miami | 21 | 21 | 0 | | San Diego | 23 | 21 | -2 |
| Los Angeles | 24 | 22 | -2 | | Los Angeles | 24 | 22 | -2 |
| San Diego | 25 | 23 | -2 | | Tampa | 20 | 23 | 3 |
| Riverside | 22 | 24 | 2 | | Riverside | 21 | 24 | 3 |
| Tampa | 23 | 25 | 2 | | Miami | 25 | 25 | 0 |

Critiques and Challenges

What does affordability mean?

- Threshold somewhat arbitrary (a week's wage for a month's rent)
- Index does not consider other expenses that vary with location like schools and groceries.
- Index ignore household size, age, composition, and life-stage considerations (earnings vs. wealth vs. earnings potential).
- Index ignores variation in household preferences

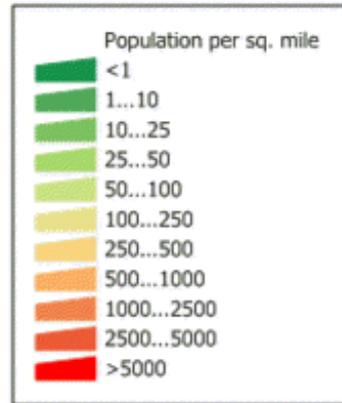
Aggregation bias

The focus on typical households and typical prices accounts for substantial variation in neighborhoods and households.

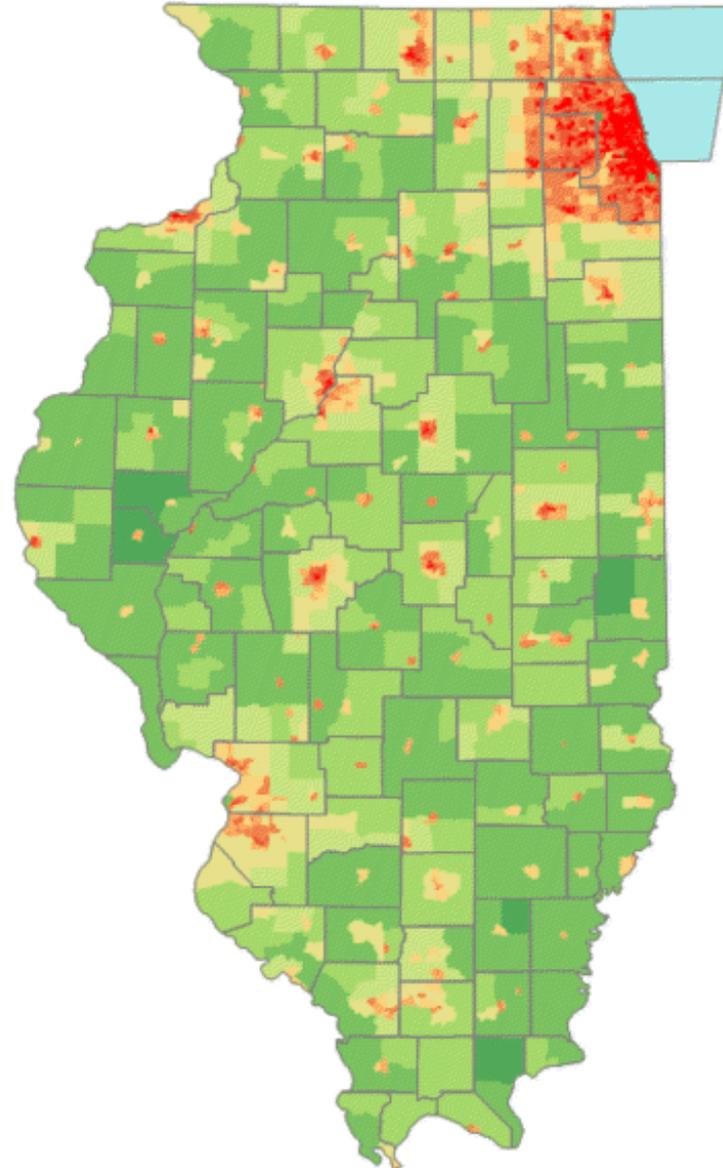
An ideal city and neighborhood should have distributions of income and housing prices that match, not averages or medians.



Challenges and critiques: VMT estimation



Source: U. S. Census Bureau
Census 2000 Summary File 1
population by census tract.



The high cost of new construction

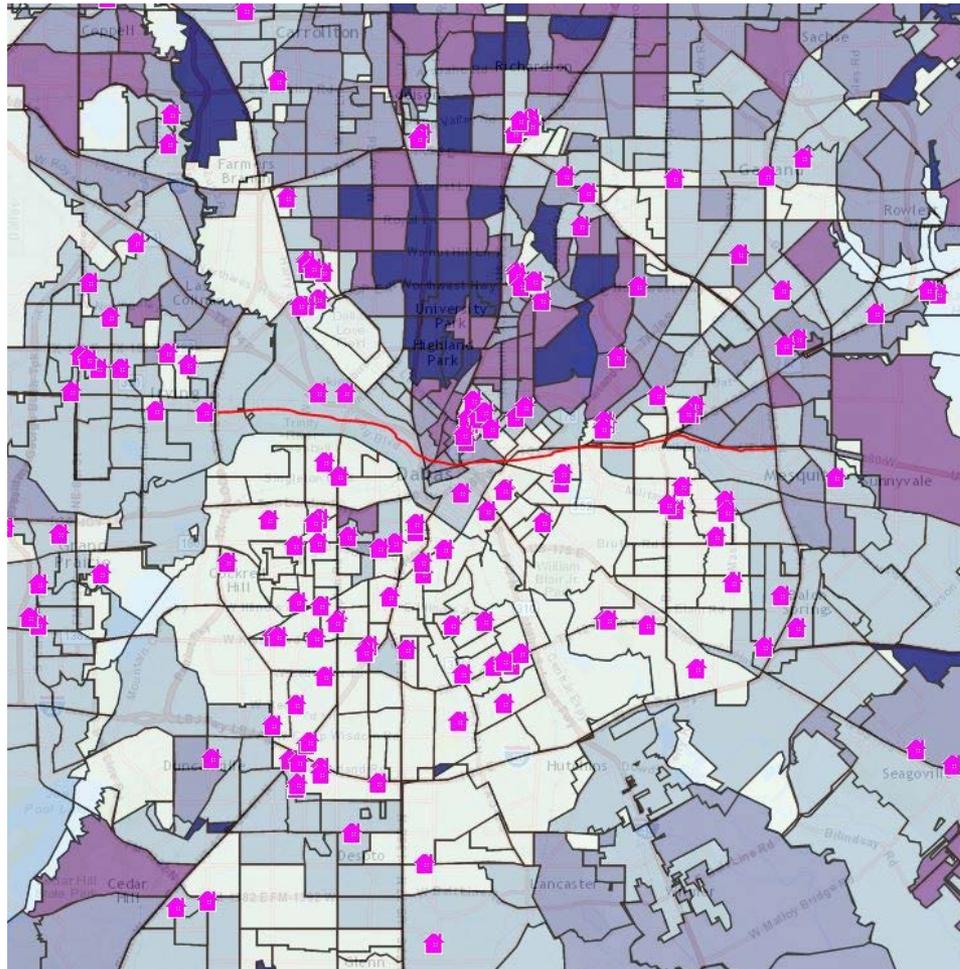
New construction is expensive. Absent deep subsidies, focusing new construction around transit is unlikely to reduce housing and transportation expenditures for vulnerable households.



View of BART Plaza

Fair housing vs. affordable housing

Texas Department of Housing and Community Affairs v. The Inclusive Communities Project, Inc.



H+T in Mexico City

National data and Mexico City overview

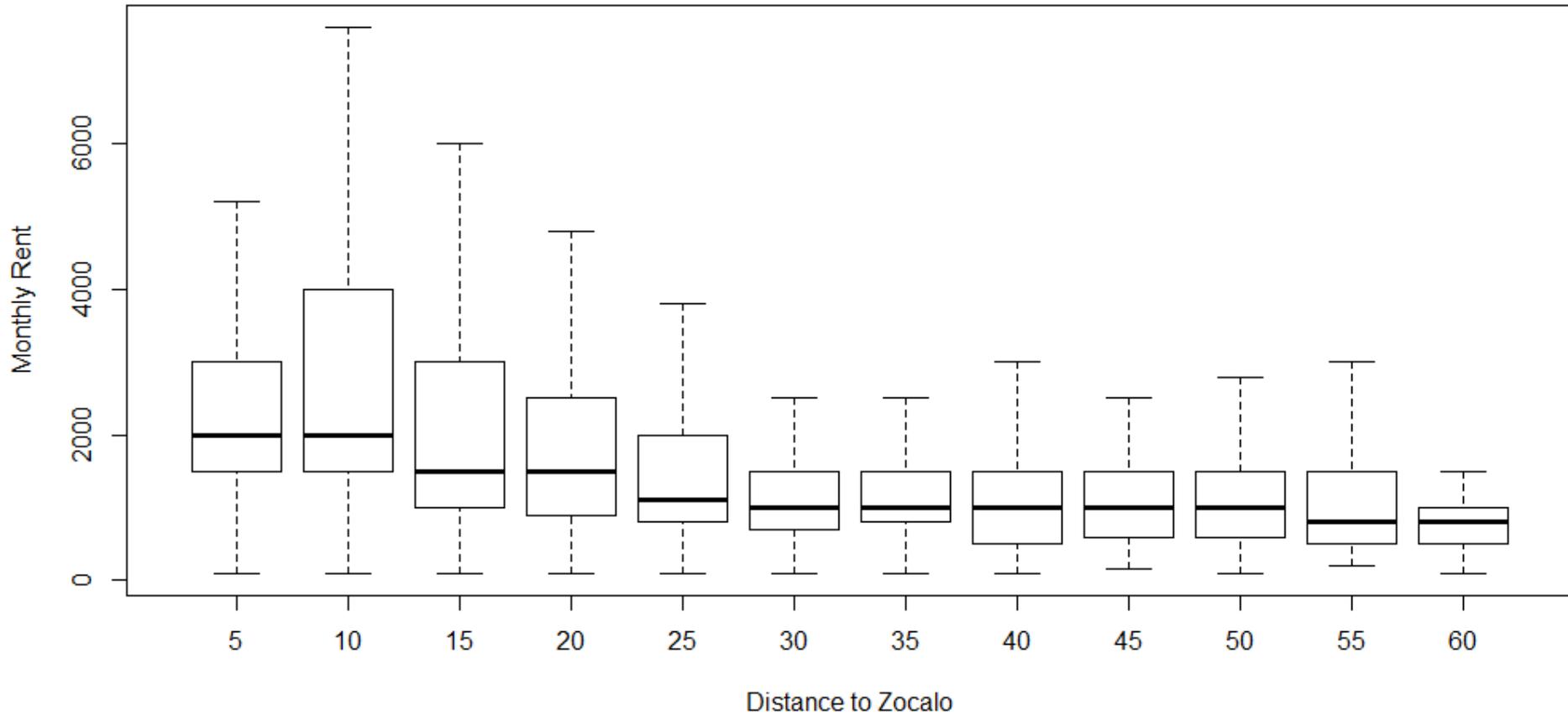
How readily could a housing and transportation affordability index be applied to Mexico and Mexico City?

- Data available on household expenditures
- Insufficient data on car ownership, transit use, and VMT
- Rely on 2007 Mexico City household travel survey
- Focus on households that did not drive on survey day (roughly two-thirds)



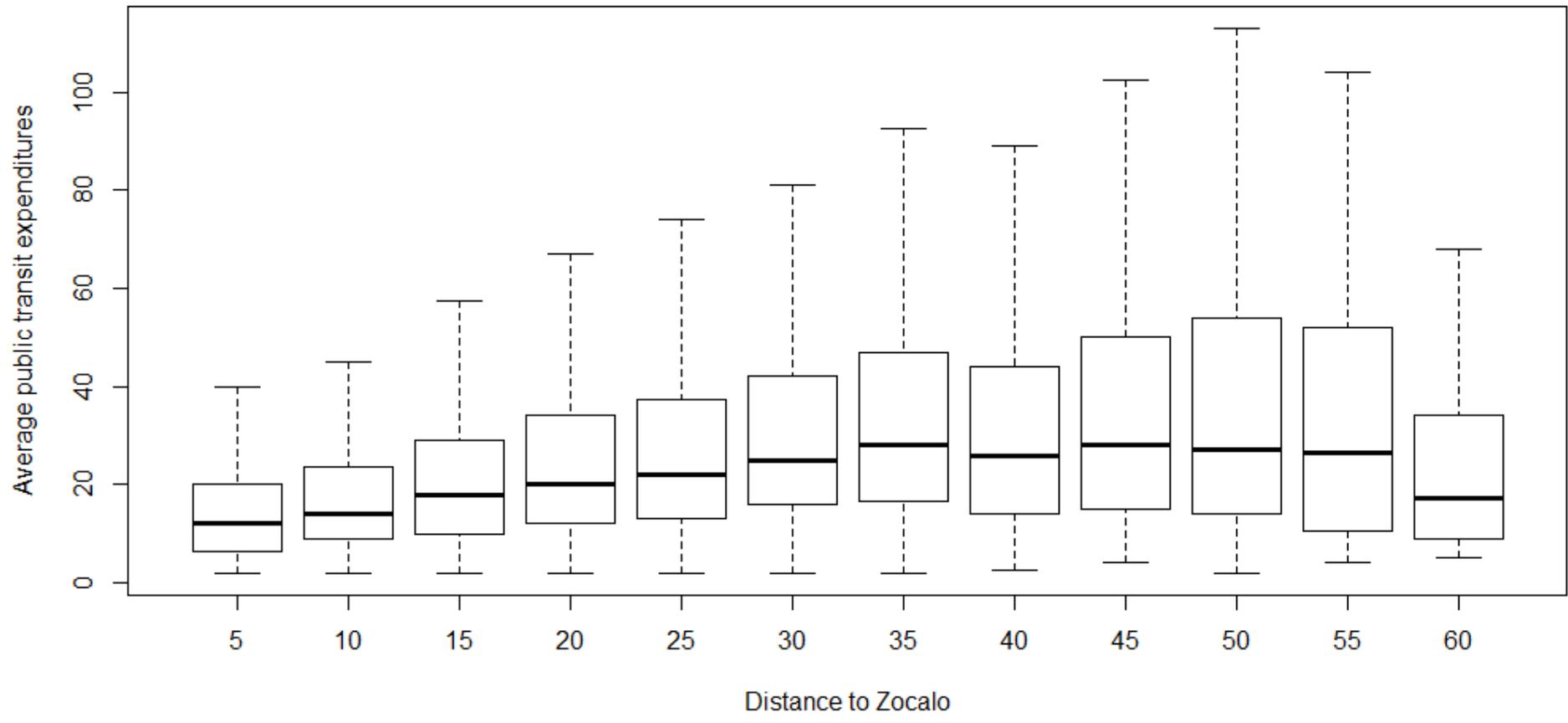
Rent by location

Average non-driving household spends an estimated 33% of income on rent in Mexico City

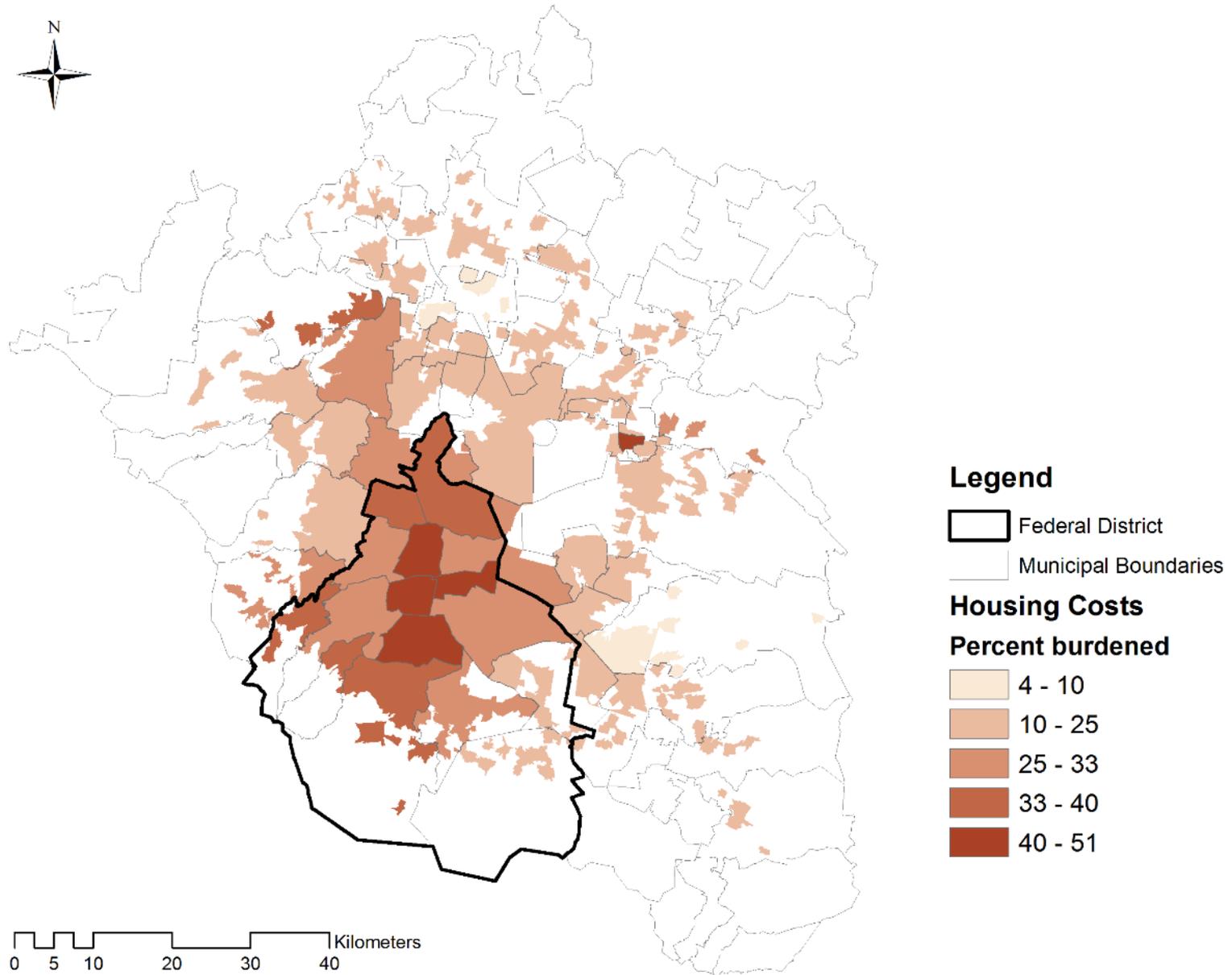


Transit expenditures by location

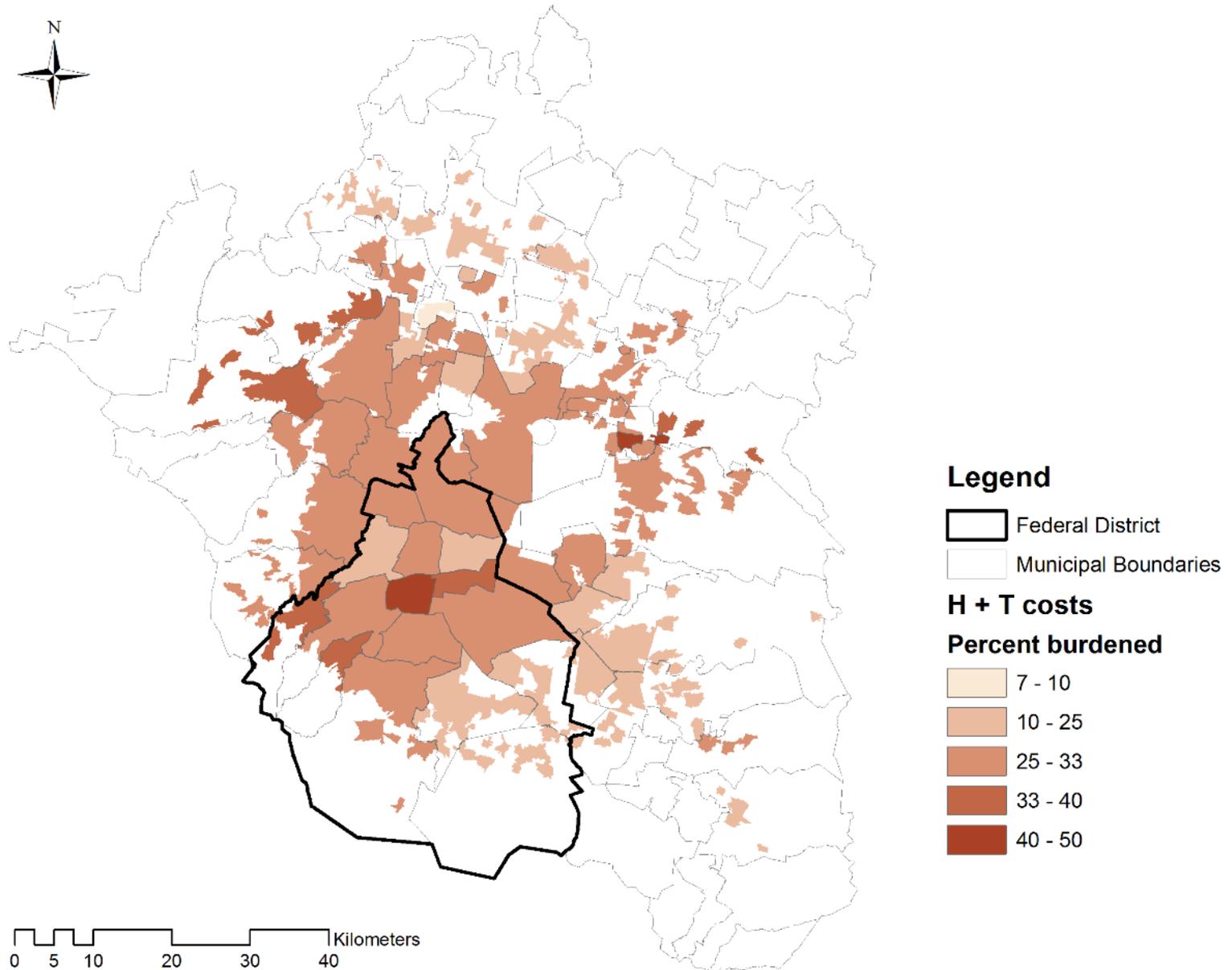
Average non-driving household spends an 15% of income on transit expenditures in Mexico City



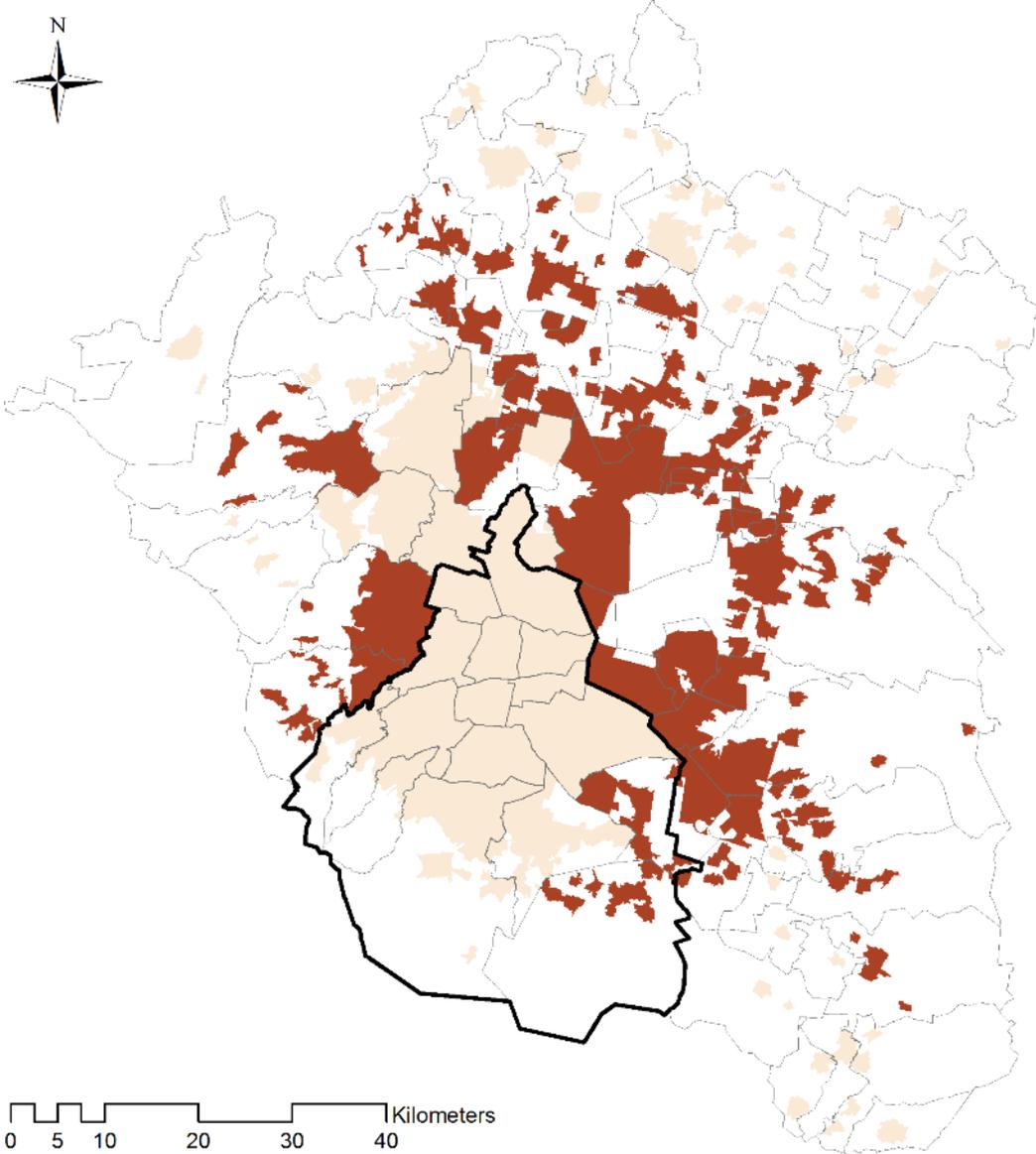
Percent of rent burdened households by municipality



Percent of H+T burdened households by municipality



Housing affordable municipalities for 25th percentile income household



Legend

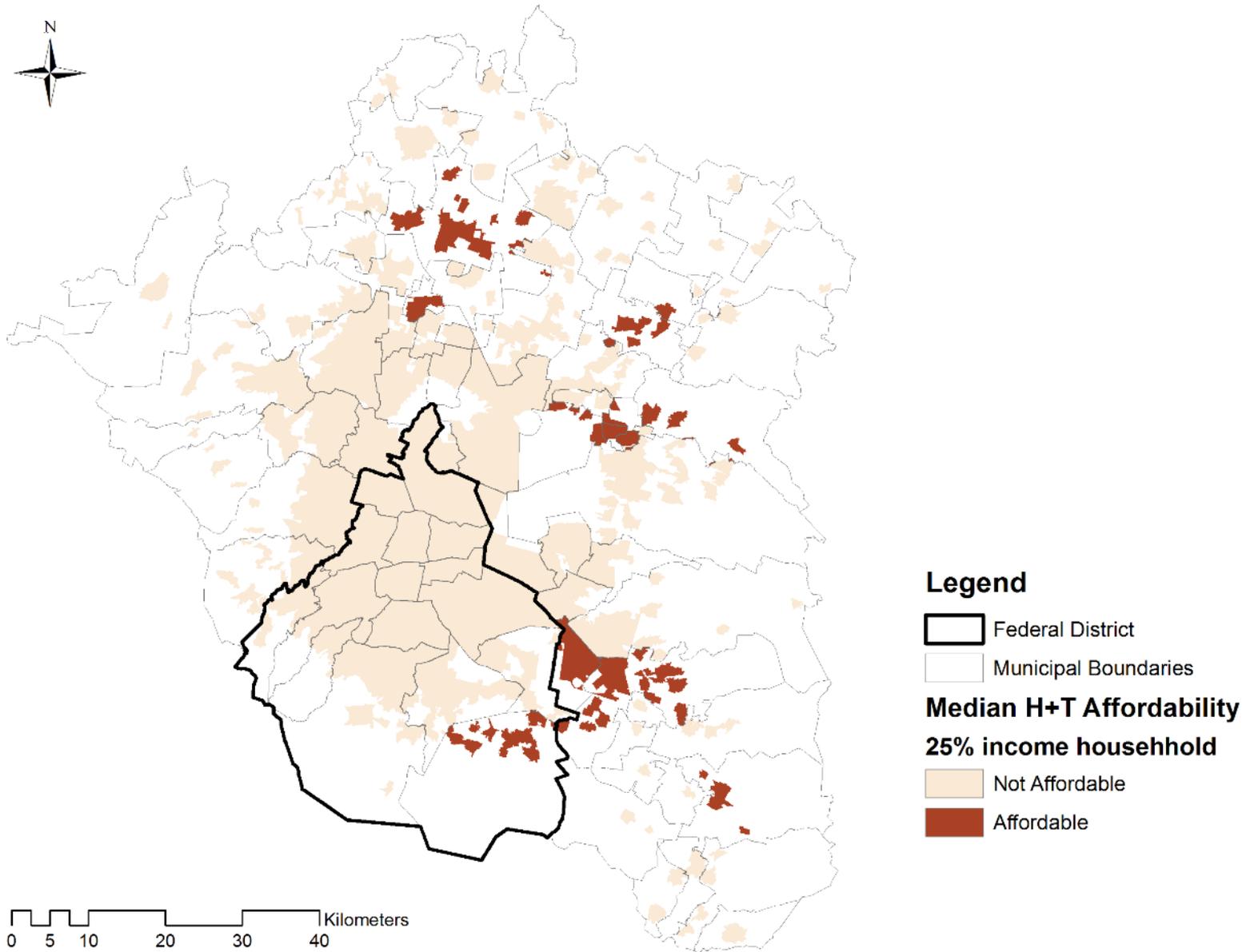
-  Federal District
-  Municipal Boundaries

Median Housing Affordability 25% income household

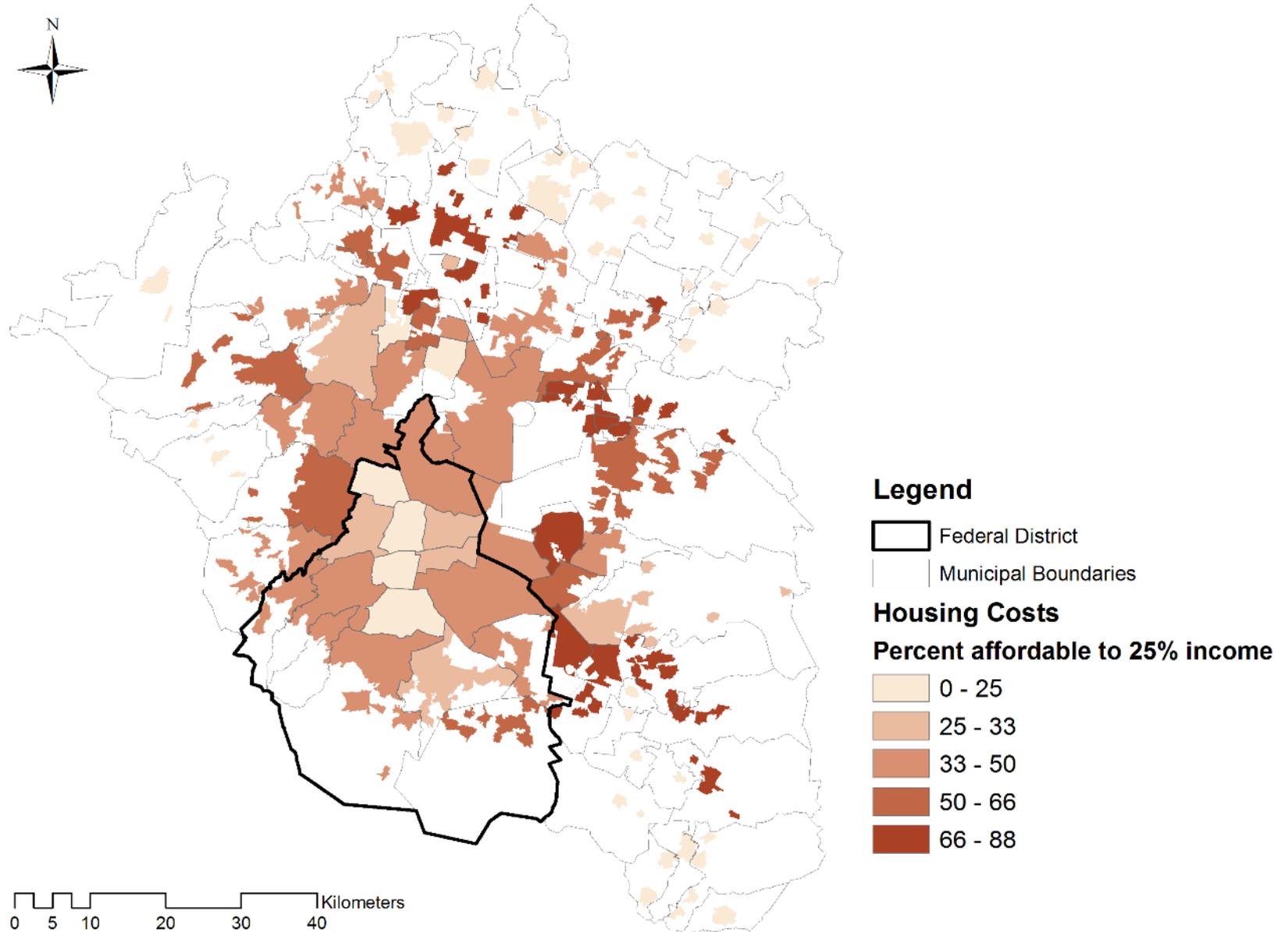
-  Not affordable
-  Affordable



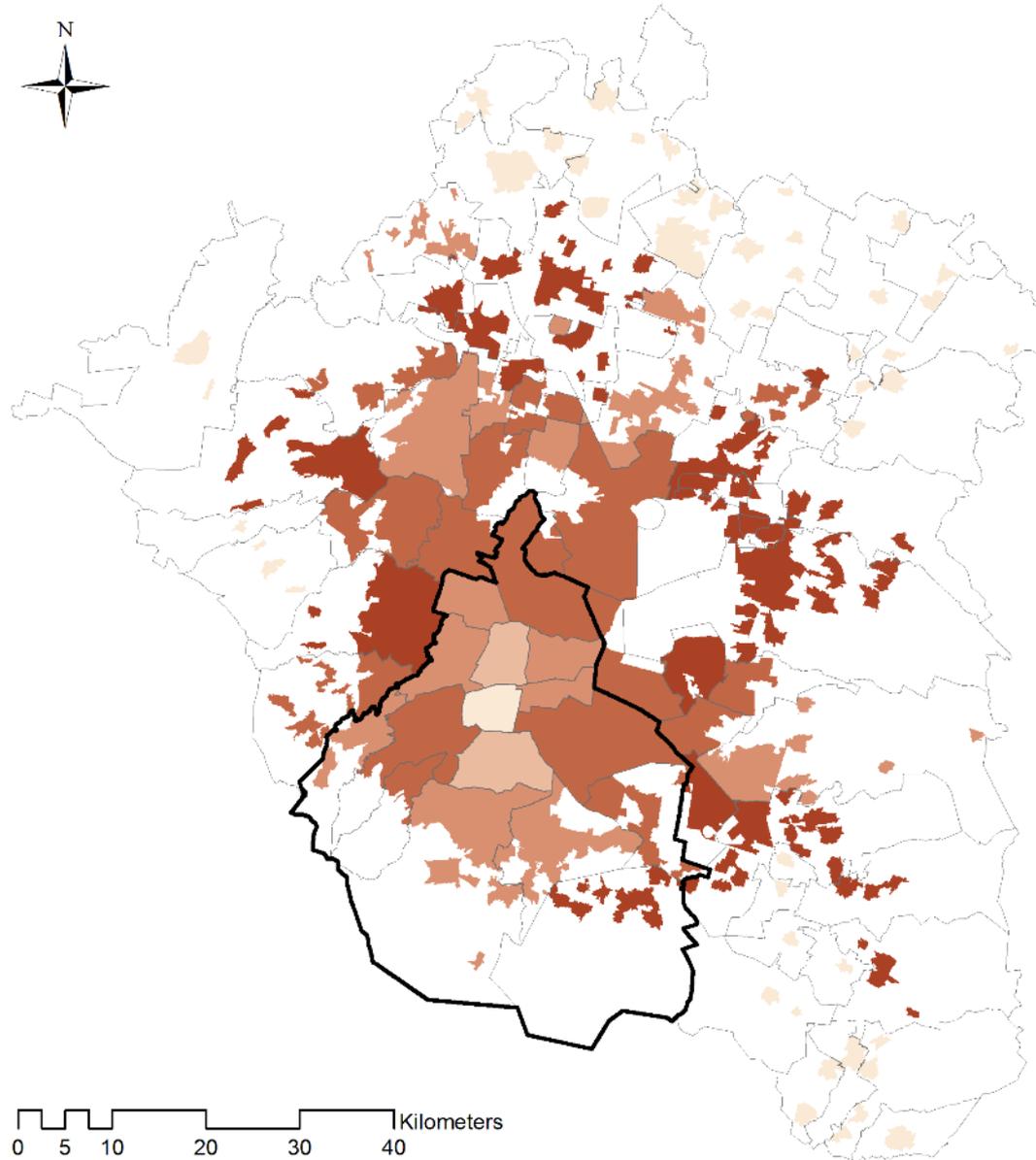
H+T affordable municipalities for 25th percentile income household



Percent affordable for 25th percentile income household



Percent H+T affordable for 25th percentile income household



Legend

-  Federal District
-  Municipal Boundaries

H + T Costs

Percent affordable to 25% income

-  0 - 25
-  25 - 33
-  33 - 50
-  50 - 66
-  66 - 93

Summary of findings

- Possible to apply an H+T index in a place like Mexico City with relative ease (at least when excluding car expenses).
- More transit-friendly central locations appear relatively more affordable when accounting for travel costs as well as housing costs.
- Since Mexico is the poorest of the OECD countries and the US is one of the wealthiest, these findings likely extend to the rest of the OECD.
- Shortage of the necessary data makes it difficult to extend this analysis beyond the Mexico City to the rest of the country.

Housing policy takeaway

- Between 1995 and 2005, public agencies funded 75% of all housing loans by value—and even more by volume—in Mexico
- Most in peripheral locations
- Higher car ownership and driving than nearby informal settlements despite similar incomes

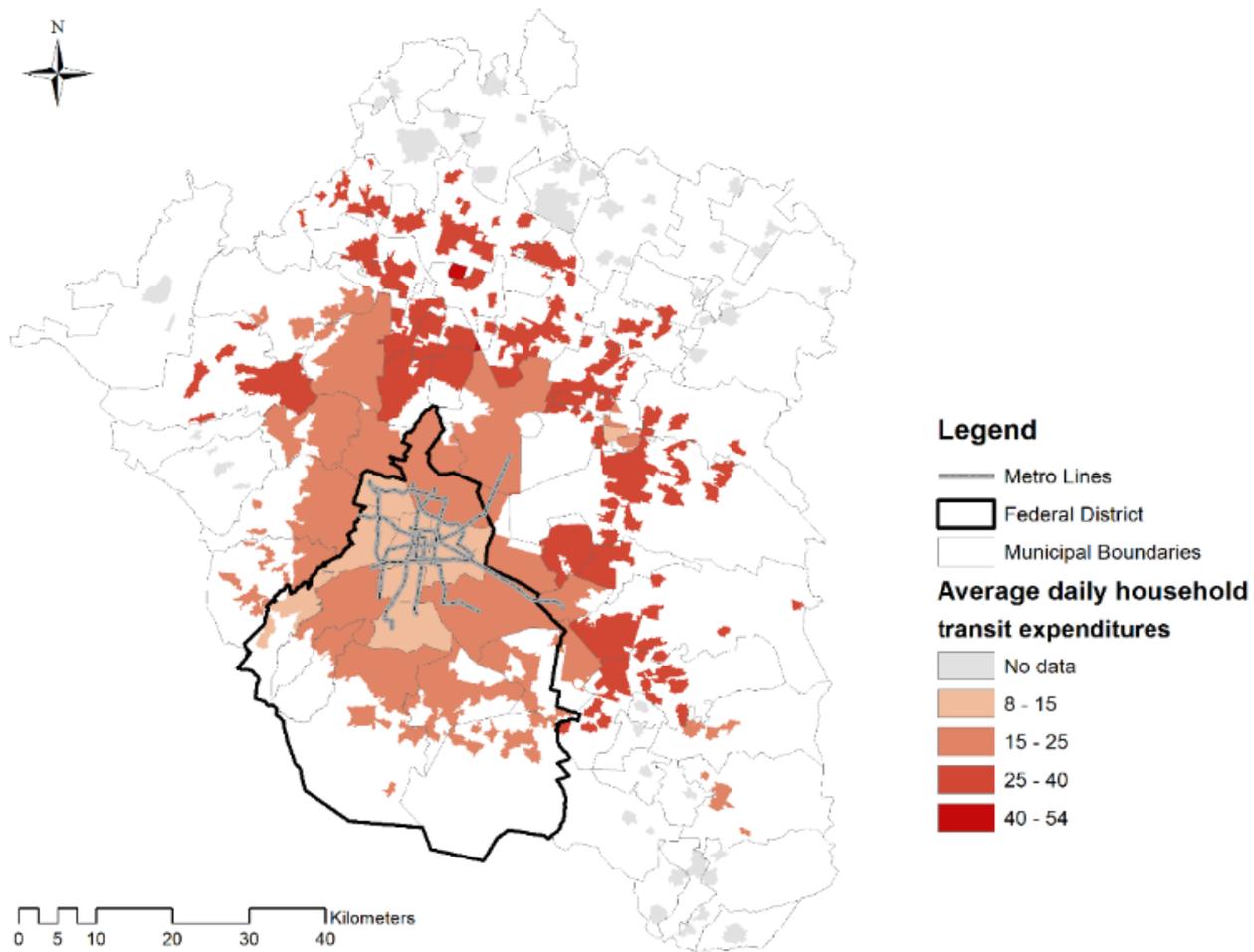
| | Traditional Development | Subsidized Development |
|---------------------------------------|----------------------------|---------------------------|
| | Mean | Mean |
| Cars per household | 0.41 | 0.62 |
| Average daily VKT | 6.2 | 15.8 |
| Monthly income (in pesos) | \$7,617 | \$8,725 |
| People per hectare in Census Tract | 109 | 204 |



Los Héroes de Ecatepec, 25km northeast of downtown (Erick Guerra, 2012)

Transit policy takeaway

Limited suburban transit service despite higher reliance of suburban households on transit



Concluding Remarks on Transferability

Potential for H+T index in other OECD nations

1. Strengthen the public and policy makers' understanding of which countries, cities, and regions are most affordable.
2. Encourage bank lending and the construction of affordable housing in neighborhoods with higher land costs but lower transportation costs.
3. Focus transit investments in a way that could help to reduce the amount that poorer households spend on transportation.

Transfer challenges: context

Relationship between transportation costs and housing location varies in different contexts.

1. Wealthy households in Mexico City generally opt to live in transit accessible areas but own and use cars.
2. May make central locations look less affordable to poor and moderate-income households than they actually are.
3. Similar differences when comparing American and European cities (Brueckner *et al.* 1999).
4. US's local control and financing of public school districts almost certainly also leads to substantial differences in housing markets when compared to other countries.

Transfer challenges: data

1. Data not always available or comes in a different form in different countries
2. No single methodology can or should be applied to all OECD countries and regions.
3. Estimating the costs of vehicle travel is likely most problematic.

Thank you
