CM² Cooperative Mobility for Competitive Megaregions

Spring Exhibition 2018

UNIVERSITY of PENNSYLVANIA
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A Transportation Capital Investment and Evaluation Simulation Model for the Northeast Megaregion (NEMR)

RESEARCH AGENDA

1. BACKGROUND

The thirteen-state Northeast Megaregion (NEMR) extends along the I-95 corridor from Portland, Maine to Richmond Virginia, and includes more than 15% of the country's residents and 14% of its jobs. This makes it America's largest and most productive megaregion by far. It also includes 38 Metropolitan Planning Organizations, or MPOs, each of which is responsible for coordinating transportation planning and investment activities in its metropolitan area.

This plethora of MPOs, and the resulting fragmentation of transportation investment decision-making has compromised the NEMR's ability to undertake needed transportation investments within and across modal categories, generating productivity and quality-of-life bottlenecks across the region. Where comparable regions in other advanced economies have undertaken major investments in state-of-the-art intra-regional and inter-city passenger and goods movement transport, the U.S. and NEMR are falling further and further behind.

2. RESEARCH QUESTIONS

Some of this coordination problem is technical in nature. Each of the NEMR MPOs uses different geographies, surveys and behavioral models, and modeling procedures to simulate alternative transportation investments and service changes. This makes it exceedingly difficult to consider or simulate or evaluate prospective projects that cross metropolitan area or state boundaries.

3. RESEARCH PURPOSE

The purpose of this three-year applied research project is to develop and test a robust travel demand and facility planning and evaluation model capable of simulating the costs and benefits of various multi-modal transportation investments as undertaken at the megaregional scale within the NEMR. Such investments might include high-speed, inter-city high-speed rail service, intra-regional bus rapid transit service, dedicated (and automated) freight movement facilities, new bridge and tunnel facilities, high-speed airport-city transit lines, and other projects to be determined. The proposed modeling procedures and datasets will be developed and implemented in TransCAD, a state-of-the-art modeling platform already in wide use across the United States.

4. RESEARCH SCOPE

The proposed project will build on and extend the traditional 4-step urban transportation planning procedures as embedded in TransCAD. These procedures include trip-generation, trip distribution, mode choice/split, and facility assignment. The results of this 4-step process will serve as inputs into subsequent economic development and land-use and real estate development models so as to be able to explore the downstream and feedback effects of major transportation investments on regional economies and urban settlement patterns.

5. SIGNIFICANCE & CONTRIBUTION

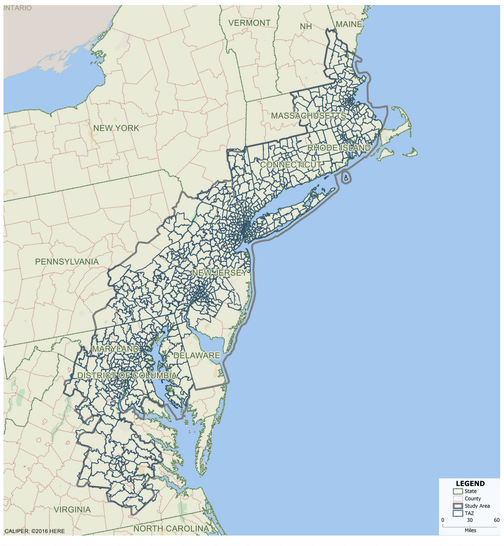
While none of the procedures used in this project are new, per se, they have never before been used at this large a geographical scale or to model such a complex system of alternative modes, facilities, and transportation investments. Nor have they been so tightly linked to regional economic and land development models. In addition to providing new planning and evaluation capabilities to states and metropolitan areas involved in joint and long-term transportation facilities planning, this project will result in data, procedures, and joint knowledge that will make the current efforts of existing MPOs more productive. It will also serve as a functioning prototype for other U.S. megaregions facing similar challenges.

6.TIMETABLE

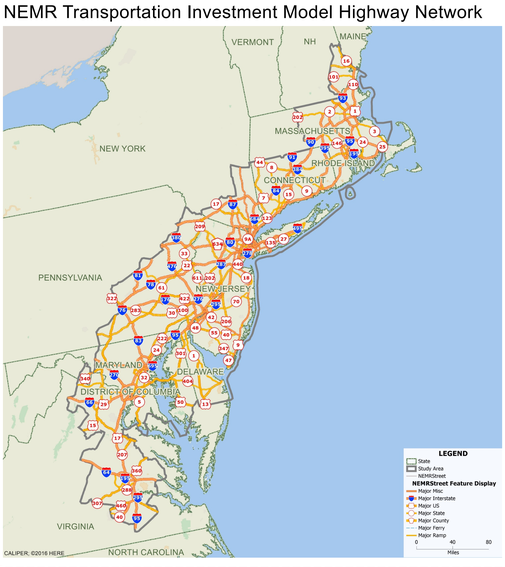
This project is organized into three, one-year phases. In Phase I, we will create the basic data structures and modeling procedures necessary to construct a 4-step multi-modal passenger and freight transportation planning model for the NEMR. In Phase II, we will use the model to investigate the transportation costs, benefits, and impacts of a proposed series of 21st Century transportation facility investments. In Phase II, we will extend the transportation model to inform a megaregional scale economic development as well as metropolitan-level land use change and real estate development models.

SELECTED FIRST-YEAR RESULTS

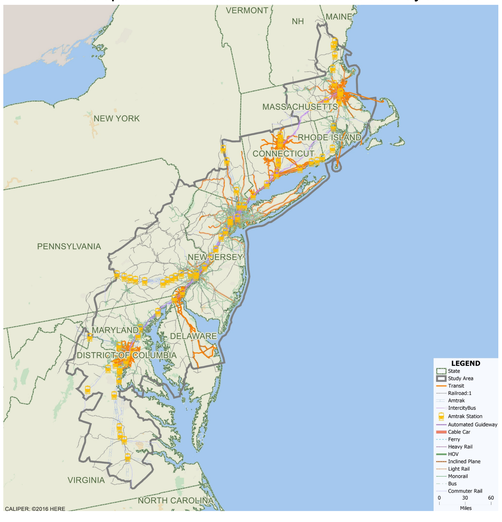
NEMR Transportation Investment Model Zone System



NEMR Transportation Investment Model Highway Network



NEMR Transportation Investment Model Transit Systems



NEMR Transportation Investment Model Example Skim-Tree Times

Matrix9 - Shortest Path Skim Matrix (Travel Time)

	1	2	3	4	5	6	7	8
31	571.20	227.59	218.35	101.74	107.01	118.61	123.04	123.13
32	547.61	199.10	194.77	73.26	78.52	92.17	94.56	94.64
33	547.68	205.32	194.83	79.48	84.74	96.19	100.77	100.86
34	568.88	233.85	216.03	108.01	113.27	125.60	129.31	129.39
35	672.32	347.00	319.49	221.16	226.42	237.16	242.46	242.55
36	521.27	196.62	168.42	70.81	74.35	79.41	87.57	89.30
37	510.20	171.95	155.37	47.30	50.84	54.75	62.90	64.63
38	590.04	247.42	216.00	122.77	126.31	130.22	137.87	140.11
39	501.72	177.59	151.83	52.94	56.48	60.39	68.55	70.27
40	586.27	271.47	234.04	146.81	150.36	154.26	162.42	164.15
41	565.31	183.07	195.57	61.51	65.15	79.10	82.81	82.10
42	605.28	219.81	235.53	102.83	103.10	118.30	122.78	118.83
43	552.82	173.71	189.43	56.71	57.01	72.21	76.68	72.74
44	553.52	181.24	191.15	57.41	61.04	75.00	78.71	78.79
45	610.42	238.15	248.05	114.31	117.94	131.90	135.61	135.69
46	689.45	315.86	326.08	192.03	195.66	209.62	213.32	213.41
47	565.16	206.59	212.32	80.75	86.01	99.66	102.05	102.13
48	635.57	274.73	281.14	148.89	154.15	167.79	170.19	170.27
49	540.70	180.93	187.34	55.09	60.25	73.99	76.38	76.47

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UNIVERSITY OF PENNSYLVANIA

PI(s): Erick Guerra, Nick Klein (Cornell), and Mike Smart (Rutgers)

The Philadelphia Story: urban renaissance and shifting travel behavior in a Northeast region

RESEARCH AGENDA

1. BACKGROUND

The objective of this project is to analyze how shifting residential location, demographics, economic activity, and preferences have contributed to changes in travel behavior in the Philadelphia Region over the past decade and a half. Cities and regions like Philadelphia have been at the heart of national increases in the use of transit, bicycles, and walking at the regional, megaregional, and national level. The metropolitan area has experienced enough demographic and spatial change in a short period of time and has enough demographic and travel variation to begin to unpack questions about the relative importance of economic conditions, demographic change, and people's preferences in shifting travel patterns.

2.RESEARCH QUESTIONS

Since 2000, many once-declining cities in the United States have experienced an economic and population resurgence – but what does this mean for travel behavior and to what extent do changes in settlement patterns, demography, the economy, and preferences contribute to changes in metropolitan travel?

3. RESEARCH CONTENTS

We examine how changes in travel are playing out in Philadelphia and its suburbs. We use two household travel surveys over a decade apart, the 2000 and 2012 surveys, from the Delaware Valley Regional Planning Commission (DVRPC), the region's Metropolitan Planning Organization. We pay particular attention to the changes among adults in their 20s and 30s, women, and minorities, as well as changes related the urban environment where people reside.

4.RESEARCH FRAMEWORK

We take two basic approaches to examining changes in travel behavior over time in the Philadelphia region. The first is to plot changes in where households reside and how members commute to work using available Census data. The Census sources provide the largest available samples of how residential location and commute patterns have changed by age cohorts and socioeconomic groups. But the Census data only provide travel information on the commute trip and individual level data (PUMS) do not include detailed information about residential location.

The second approach addresses these limitations by relying on travel diary data for individual households to test whether travel behavior has changed over time in the Philadelphia region. We estimate models of travel behavior using data from the 2000 and 2012 household travel surveys collected by the regional metropolitan planning organization, the Delaware Valley Regional Planning Commission (DVRPC), and compare the parameter estimates statistically. The household travel surveys provide the richest available data on household members' complete travel behavior on a typical weekday.

5.TIMETABLE

This project has been completed and led to a peer-reviewed publication in the *Journal of Transport Geography*. A final Cm2 report has been submitted.

FINDINGS

1.Millennials

The travel behavior of young people changed, but so did the travel behavior of older groups. In the Philadelphia region, Millennials are not unique in their declining travel by car. Similarly, car-ownership rates declined at about the same rate for all age ranges over the period. There was also little change in the commute to work by transit, as measured by the Census. Most notably, across all model specifications, we find that the independent effect of being young remains unchanged from 2000 to 2012, though this group was consistently the most likely age-group to be car-free and to not have traveled on the survey day.

2. Gender, race, and income

The changes we observed by age-cohort pale in comparison to the changes by gender, race, and income. Women were statistically significantly more likely than men to have a car-free travel day in 2000, but significantly less likely in 2012.

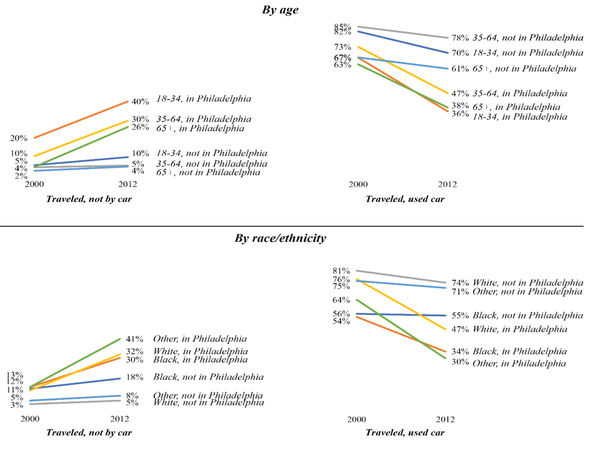
In 2000, black respondents were statistically more likely to travel without a car than white and other respondents. By 2012, however, there was no behavioral difference after controlling for other factors. he difference between low-income residents' and wealthier residents' travel behavior also shrank over time, though it remained substantial and statistically significant in 2012. Low-income residents were nearly three times as likely as wealthier residents to travel without cars in 2000, but only twice as likely in 2012.

3.The built environment

The local built environment appears to be more strongly correlated with car-free travel routines in 2012 than in 2000. As shown in the Table and Figure on the right, population density and Walk Scores were weakly and statistically insignificantly associated with car-free travel routines in 2000. By 2012, however, living in a denser, more walkable neighborhood was a much better predictor of car-free travel.

Below: Traveler Type, 2000 and 2012, by age and race

Sources: Census 2000 and 2010-2014 5-year American Community Survey



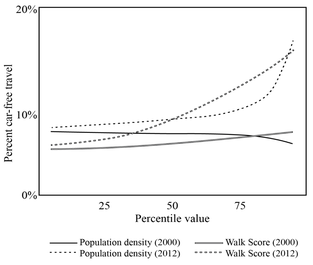
	Dependent variable: Car free travel			
	vs. Other travel		vs. No travel	
		(2012)		(2012)
Philadelphia household	1.616***	-1.094***	1.442***	-1.046***
	(0.174)	(0.236)	(0.206)	(0.275)
People per acre	-0.005	0.028***	-0.004	0.015*
	(0.005)	(0.007)	(0.006)	(0.008)
Walk Score (0 - 100)	0.003	0.009**	0.001	0.015***
	(0.003)	(0.004)	(0.004)	(0.005)
Transit accessibility	0.176***	—	0.099***	—
	(0.031)		(0.031)	
Household size	-0.057	—	-0.171***	—
	(0.042)		(0.049)	
Kids in household	-0.115	—	0.370***	—
	(0.121)		(0.135)	
Low-income household	1.023***	-0.365*	0.162	—
	(0.151)	(0.193)	(0.114)	
Female	0.168	-0.367**	0.250*	-0.320*
	(0.123)	(0.161)	(0.141)	(0.185)
Black	0.639***	-0.507**	-0.132	—
	(0.154)	(0.227)	(0.127)	
Employed	-0.105	—	1.199***	—
	(0.094)		(0.105)	
Age 18 - 24	1.102***	—	0.854***	—
	(0.151)		(0.170)	
Age 25 - 34	0.433***	—	0.371**	—
	(0.131)		(0.156)	
Age 35 - 44	0.301**	—	0.22	—
	(0.135)		(0.156)	
Age 45 - 54	0.274**	—	0.494***	—
	(0.118)		(0.135)	
Constant	-5.155***	0.434**	-3.162***	-0.27
	(0.300)	(0.203)	(0.306)	(0.217)
Observations	9,462		3,251	
Log Likelihood	-2,276.03		-1,512.82	
McFadden Pseudo R2	0.26		0.23	

Notes: Coefficients for 2012 are additive with those from 2000; stars indicate statistical significance. *p<0.1; **p<0.05; ***p<0.01; — indicates that the parameter for 2012 was not statistically significant (the 2012 effect was not different from the 2000 effect) is excluded from the final model estimates.

Left: Binomial logit model predicting car-free travel against all other travel and no travel (Sources: DVRPC 2000 and 2012)

Below: The built environment and car-free travel over time

Simulated model predictions based on varying neighborhood population density and Walk Score for all survey respondents, DVRPC 2000 and 2012



Summary

Taken together, these three findings fit an overall narrative about how urban gentrification and the suburbanization of poverty have led to dramatic changes in urban travel patterns in Philadelphia.

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Summer Forum 2018

UNIVERISTY OF PENNSYLVANIA
PI: Erick Guerra
GRAs: Juan Benitez, Meiqing Li, Neil Narayan, Jolene Lim, Nikhil Tangirala, Jonathan Yuan

Transportation and Land Use across US and Mexican Cities and Megaregions

RESEARCH AGENDA

1. BACKGROUND

Megaregions inherently cross borders, often national ones. Of the eleven emerging US megaregions identified by the Regional Plan Association in its seminal work, three include Mexican cities (Figure 1). Moreover, cross-border commutes, tourism, and economic flows are important components of local and metropolitan economies and cultures in places like San Diego, Tijuana, El Paso, and Juarez. According to the 2015 Intercensus (INEGI 2015), around 5-10% of Mexican commuters from border cities and municipalities work in the United States (Figure 2). Even in many central parts of Mexico, a sizable fraction of the workforce commutes to the United States.

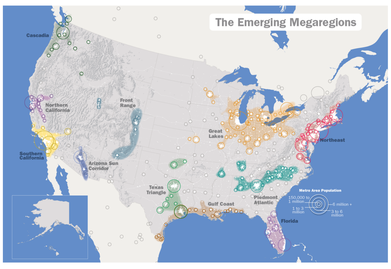

Figure 1. Regional Plan Associations map of emerging megaregions

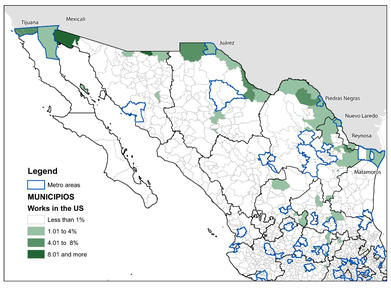

Figure 2. Percent of commutes to the United States by Municipality

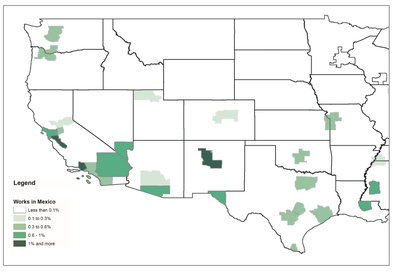

Figure 3. Percent of commutes to Mexico by MSA

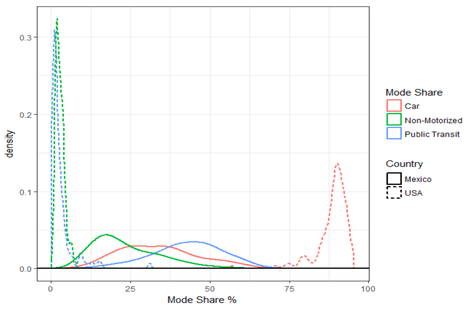

Figure 4. Distribution of mode splits across 100 largest urban areas in Mexico and the United States

Studying the relationship between land use, socioeconomic, and commute behavior across multiple regions in multiple countries can help shed light on not just on the strength and relative importance of different relationships, but also their consistency and the role of regional and social context. Of particular interest will be questions about the relative importance of transportation supply, household income, and the built environment in determining the radically different commute patterns seen on each side of the border. Figure 4 plots the percent of commutes to work by transit, car, and non-motorized modes (walking/biking) in the 100 largest metropolitan areas in Mexico and the United States in 2015. Mexican cities are highly multimodal with substantial and continuous variation in modal importance. Even in the most car-reliant city, La Paz, 40% of commuters walk, bike, or take transit. In the US, by contrast, nearly everyone drives to work, with just a few individual cities that have less than 90% of commutes by car. Income almost certainly plays a role. Mexican commuters have average household incomes that are around 8 times lower than American commuters. So does the built environment. Average metropolitan population densities are an order of magnitude higher in Mexico than in the US.

2.ROADMAP

While the study will include the hundred largest metropolitan areas from each area: particular attention will be paid to four megaregions: the Northeast, Central Mexico, the Texas Triangle plus Northern Mexico, and Southern California plus Baja California. The northeast and central Mexico are the most populous and economically productive parts of each country, while the border regions are mutually dependent and deeply economically entwined. Within this collaboration, we propose to 4 individual research tasks:

- Collect and summarize socioeconomic and travel data across the 200 metropolitan areas

This task, completed as of April 2018, will provide the basis for future work. We rely primarily on four roughly comparable datasets: the 2010 US Census, the 2015 US 5-year ACS PUMs, the 2010 Mexican Census, and the 2015 Intercensus.

- Define and analyze the cross-border megaregions with an emphasis on the importance of cross-border economic and labor flows

Following a methodology developed by Suárez, Murata, and Campos (2016), we estimate that 54% of employed Mexicans work in the informal sector in Mexico's hundred largest cities. We will also use the EMIF-Norte (Encuesta sobre migración en la frontera norte de México), which has been measuring and characterizing migratory flows between the US and Mexico on a triannual basis since 1993.

- Analyze similarities and differences in commute strategies of the working poor

This task will rely on data from the US Pubic Use Microdata and the Mexican Intercensus to define and cluster low-income commuters based on geography, commute patterns, and job types.

- Explore how the relationship between income, land use, and commute patterns vary by region and by country

The first task will be to model the commute choice as a function of socioeconomic and geographic features using a hierarchical choice model that allows for variation across cities, regions. We will then test whether combining regions (both within across borders) improves model fits and where the relationship between predictor variables like population density or income is consistent or varies substantially. Particular attention will be given to identifying whether the travel behavior of Mexicans and Americans in transnational border regions is more similar to one another than to commuters in the Northeast or central Mexico megaregions.

3.RESEARCH PRODUCT

This project will result in a report to the CM2 that describes the work conducted and findings in detail. A subset of the analyses will be submitted for peer-reviewed publication in a leading transportation or planning journal. We will also present findings to the Transportation Research Board and other local and national conferences. The project will also lead to strengthened cross-border collaborations between the University of Pennsylvania and CentroGeo.

FINDINGS

Figures 5 and 6 plot the comparable data we have collected of population density, car commutes, and traffic fatalities. There are clear differences in aggregate relationships that we will begin to test this summer. We will then test whether combining regions (both within across borders) improves model fits and where the relationship between predictor variables like population density or income is consistent or varies substantially.

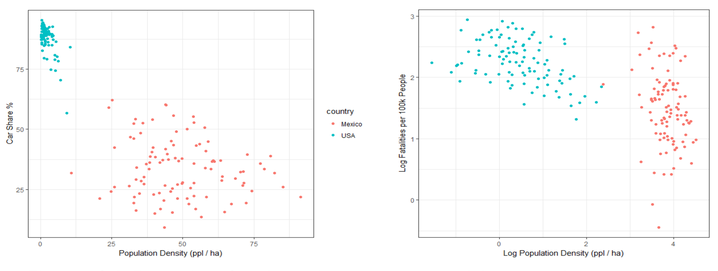

Figure 5 & 6. Proportion of workers who commute to work by car against metropolitan population density in Mexico and the United States (left); Traffic fatality rates against metropolitan population density in Mexico and the United States (right)

The majority of low income US workers (81.95%) commute by driving, similar to the overall population. In Mexico, on the other hand, the highest proportion of low income workers use public transit to commute (48.66%) – this is slightly higher than the overall proportion of transit riders (Figure 7).

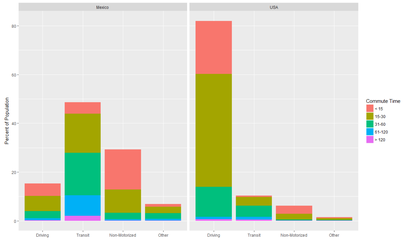

Figure 7. Commute mode and time of the population with lowest income quintile in the US and Mexico

The University of Texas at Austin
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University of Pennsylvania[1] and The University of Texas at Austin

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Equitable access to transit within and across megaregions

RESEARCH AGENDA

1. BACKGROUND

There is increasing concern about equitable access to transit within, and across, megaregions and what this means for access to jobs, amenities, and live in economically and racially diverse neighborhoods. The average household in the United States spends more on transportation than on any budget item aside from housing. How much they spend is strongly influenced by where they live. In many cases, cheaper housing is, by virtue of its location, offset by more expensive transportation. Concerns about *location affordability* date back decades, but have been gathering steam in recent years.

In this project, we explore how housing and transportation costs, and transportation time, varies by income and race across the nation, and then within three megaregions: Northeast (Boston-Washington); the Texas Triangle; and Cascadia (Seattle-Portland). Together, these three megaregions house a quarter of the national population, and all three regions are witnessing increased housing market pressures, which raise important concerns about equitable access to transit.

2. RESEARCH QUESTIONS

- Is incorporating location affordability into the siting of new subsidized housing projects tantamount to steering such developments into predominantly African American and Latino neighborhoods?
- Furthermore, does the answer vary across metropolitan regions, perhaps conditioned by differing spatial patterns of racial and ethnic segregation, housing costs, and transportation infrastructure?
- Finally, could the goal of decreasing transportation costs reduce a household's ability to access amenities that directly affect household outcomes within and across markets. And how does this vary across mega-regions?

3. RESEARCH FRAMEWORK

This paper uses several databases to estimate housing costs, transportation costs, the location of existing and new subsidized housing, and household and neighborhood characteristics.

1) The Center for Neighborhood Technology's housing and transportation cost index.
2) Tract-level neighborhood information about poverty rates, household income, and commute times, from the American Community Survey and data on school test scores and job-accessibility from various sources.
3) A national database of subsidized housing, including existing, new, and expired properties from various sources including: publicly available data from the U.S. Department of Housing and Urban Development (HUD); private data from HUD; and data from the National Preservation database.

We use these data to explore variation in housing costs, transportation costs, commute times, and access to neighborhood amenities, and how they vary across race and income by tract, city, metro, and megaregion level.

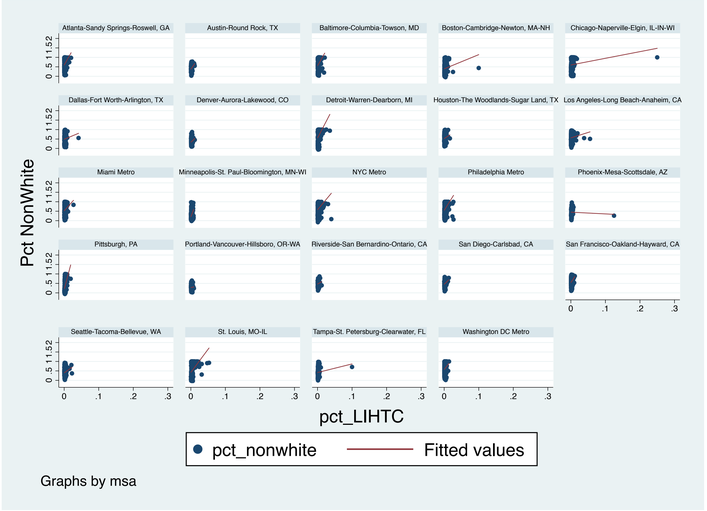
4. TIMETABLE

The research team has compiled the database and is in the process of developing descriptive statistics about transportation costs and the citing of subsidized housing at the metropolitan level.

Over the coming months we plan to expand our analysis to look at other neighborhood amenities and explore variation at the mega-regional level.

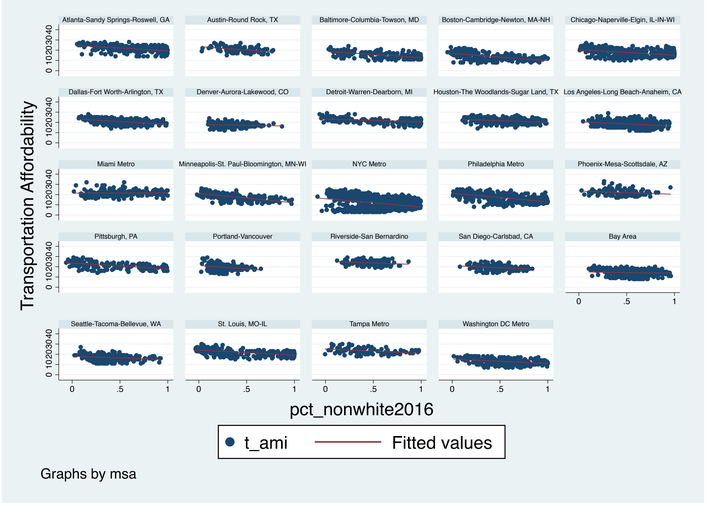
ACHIEVEMENTS

1. Developed a national tract-level database of transportation costs, household race, and subsidized housing.



Takeaway 1:

Properties developed through the Low Income Housing Tax Credit program tend to be located in areas that are more highly minority



Takeaway 2:

Tracts with lower transportation costs tend to be more highly minority

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Summer Forum 2018

UNIVERSITY OF PENNSYLVANIA
PI(s): Robert Yaro and Marilyn Taylor
GRA(s): Douglas Land, Angus Page, Shuangdi Dou

MOBILIZING INVESTMENT IN AMERICA'S TRANSPORTATION INFRASTRUCTURE

RESEARCH AGENDA

1. BACKGROUND

America urgently needs to invest in its infrastructure to fix the calamitous state of its rails, roads, bridges, highways, streets, airports, and ports. Decades of disinvestment and increases in population and economic activity have resulted in a system that is congealed and rapidly deteriorating further, creating unsafe conditions for Americans and limiting capacity for future economic growth. Existing systems exacerbate income inequality and extend already long journeys to work into even longer durations, yet there has been no progress in Washington to marshal new and increasingly essential investments. Mobilizing to design and implement solutions targeting our aging transportation is urgently needed.

2.RESEARCH QUESTIONS

Leaders across the United States will need to advance new strategies to guide the design and implementation of infrastructure initiatives. These strategies must consider the following questions:

- How should the federal role be redefined?
- Through what policies and tools will can the federal government provide leadership?
- What are the tasks that only the federal government can do?

3. RESEARCH CONTENTS

We are long overdue for bold thinking about the future of America's mobility system, and it's time to get back on track. We propose 10 strategies to mobilize investment in transportation infrastructure:

1. Get Federal Funding Right
2. Pay the Actual Cost of Congestion
3. Create and Capture Value
4. Provide Public Benefits Using Public Finance Authorities
5. Streamline Project Delivery
6. Use Open Data Platforms and Dynamic Traffic Management
7. Get Ahead of New Technology
8. Optimize the System
9. Invest in Logistics
10. Plan Ahead for High-Speed and Intercity Rail

4.RESEARCH FRAMEWORK

The work of this studio was informed by site visits to two US metro regions Denver and Los Angeles, each of which has created new urban and regional rail networks over the past two decades. Our report describes how successive mayors each advanced the vision while creating new funding streams to support transportation infrastructure investment.

5. ROADMAP

Two specific examples of infrastructure investments from Los Angeles illustrate how these strategies will work in practice, but on a national scale and across the many geographies where we are proposing interventions, there are many other types of considerations to be made.

We propose project frameworks at different geopolitical scales to align decision-making, funding/financing, and governance with the geographies where problems occur and benefits accrue.

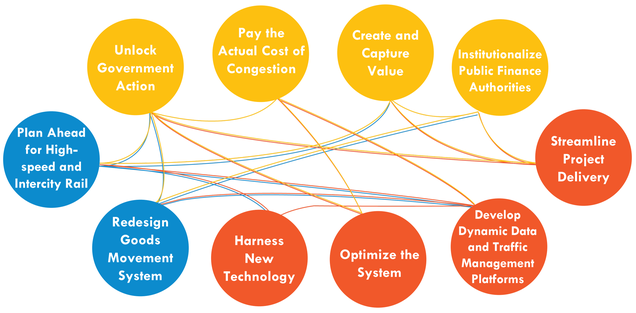
6.TIMETABLE

America's infrastructure urgently needs new strategies targeting funding, efficiency, and vision for the next generation. A complete overhaul of the infrastructure planning and procurement process is required to lower costs and speed delivery of needed projects. The time for investment is now.

ACHIEVEMENTS

Transforming Mobility in Los Angeles

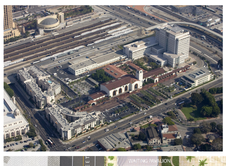
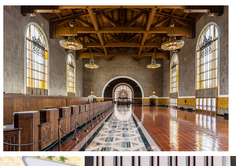
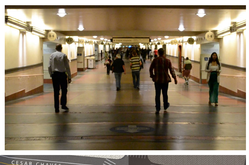
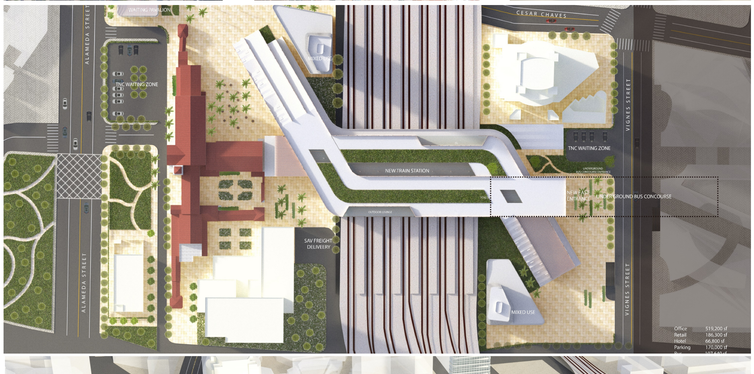
10 Strategies
Our congealed road networks, inadequate transit options, and clogged logistics hubs are unacceptable barriers to economic prosperity for millions of Americans. Each of these ten strategies supports one of three objectives that must be achieved to resolve the issues with our aging system and expand it to support the future growth of our nation: funding, efficiency, and vision. Although some strategies are cross-cutting, contributing to the achievement of multiple objectives, they are organized by the objective most closely aligned with their outcome.



LA Union Station
The historic Los Angeles Union Station was built in 1939 during the boom of the railway age – an era in which travel by train was prestigious, exciting, and glorified through architectural significance. Following the post-war decline of rail, the station, in a narrative shared by many infrastructure assets, weathered decades of disinvestment.

We envision Union Station not only as a hub for the Los Angeles transportation system, but also as a cultural hub for Downtown Los Angeles. The design of the station and the surrounding area serves to connect Union Station to nearby assets, such as the LA River, City Hall and other institutions, reknitting the surrounding areas into a unified community. We ultimately aim to establish Union Station not only as inspiring experience for those who pass through it, but as an inspiration and a model for mobilizing investment in infrastructure across America. As we conceive it, this project will promote transit use and enhance the economic vitality of its surrounding neighborhood by spurring new development and providing connections to nearby attractions.

In our proposal for LA Union Station, we have aimed to accommodate expected ridership growth, provide an ennobling and exhilarating experience for visitors, craft a focal point for the region's future economic development and urban identity, and support a less automobile-reliant Los Angeles lifestyle. Aiming to reestablish transit's position in the popular imagination, our vision for Union Station prioritizes and celebrates travel by transit and by rail - both regional and intercity rail as well as America's first High-speed Rail network.

TEXAS The University of Texas at Austin
Penn University of Pennsylvania
LSU Louisiana State University
TSU Texas Southern University