CM² Cooperative Mobility for Competitive Megaregions

Fall Exhibition 2018

UNIVERSITY OF TEXAS AT AUSTIN

PI: Stephen Boyles
GRA(s): Priyadarshan Patil, Venktesh Pandey

Beyond Political Boundaries: Constructing Network Models for Megaregion Planning

RESEARCH AGENDA

1. BACKGROUND

Megaregions transcend state and political boundaries today, and are characterized by trade and infrastructural connections. They involve multiple cities and economic zones, often spanning many states. In current practice, Megaregion network models are not developed on this scale, due to current models being developed by Metropolitan Planning Organizations (MPOs) or Departments of Transportation (DOTs), which focus on county/city scale and state scale, respectively. This mismatch of network model scale impacts long-range network planning process, specifically traffic assignment on the network. Traffic assignment allows us to predict roadway volumes, travel times, vehicle-miles and vehicle-hours travelled, and other such metrics. To achieve more accurate planning goals for megaregions, the mismatch between traditional models and megaregion models has to be addressed and new methods developed. These new models and methods should not only focus on the interactions between multiple cities and states, but also be computationally solvable and tractable, given current resources. This project aims to address this gap and develop such methods to balance realism and accuracy of megaregion network models.

2.RESEARCH QUESTIONS

The two key questions we seek to address are (1) How to **partition a large network into smaller subnetworks**, in a way which allows parallel computation; and (2) How to **quantify the interactions between these subnetworks**, allowing changes in a subnetwork to impact other subnetworks. These two questions impact the computation time required and the accuracy of the model respectively.

3. RESEARCH CONTENTS

The traffic assignment problem has been well studied over the past few decades, and with advances in computational power, new classes of algorithms have been documented. Currently, there exist link-based, path-based, and bush-based methods for solving the traffic assignment problem. One such algorithm, the DSTAP method, was developed by Jafari and Boyles (2017), which partitions a regional network into smaller subnetworks, solves for equilibrium on the subnetworks, updates a simplified and abstracted master network with the results, equilibrates the master network, and iterates until convergence. It has been shown that the algorithm converges regardless of the partition chosen and provides computational savings of roughly 50% on the Austin network.

An open question from their research is about finding an optimal way to choose partitions. The question is even more crucial in the context of megaregions. The research team plans to investigate various partitioning schemes and observe their correlation to real-world political and social boundaries. Previous studies on partitioning do not yield any conclusive evidence, and this study wishes to address it.

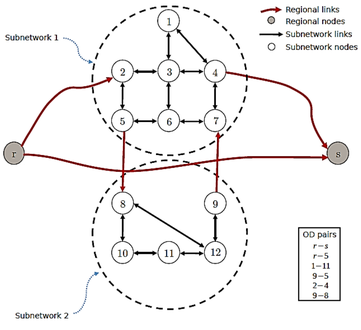
4.RESEARCH FRAMEWORK

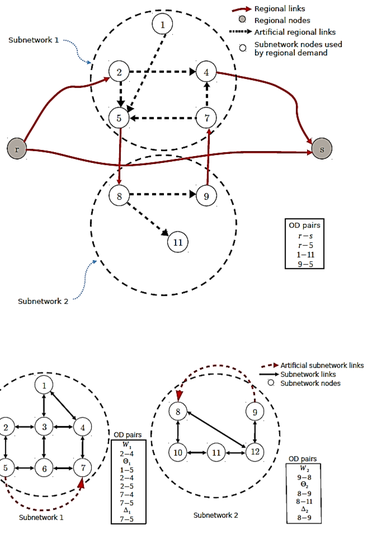
The DSTAP algorithm captures subnetwork interactions using a bush-based sensitivity analysis technique. The research team plans to extend these techniques to provide a formal quantification of the interaction metrics between different cities within a megaregion, measured by the influence on the demand and flows in one city due to changes in another city. The primary network to be used for this study is the Texas Statewide Analysis Model (SAM) developed by TxDOT, which encompasses the Texas Triangle megaregion.

RESULTS

DSTAP Methodology

The decomposed approach for the static traffic assignment problem (DSTAP) algorithm partitions a larger network into smaller subnetwork and considers |U|+1 assignment problems for a network with a set U of subnetworks: there are |U| subproblems, one corresponding to each subnetwork, and one master problem which is derived from the full network. Each iteration of DSTAP starts by partially solving the master problem, using the most recent information on travel times from the subproblems. The output of the master problem provides the regional demand for each subproblem ("external trips" in planning parlance). The subproblem flows and travel times are then updated and solved partially in a parallel fashion.

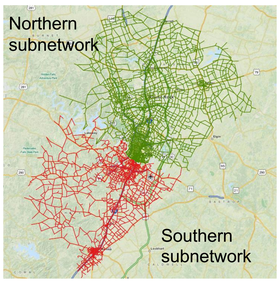


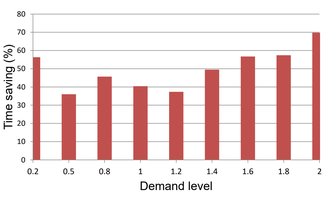


Subnetwork problem for DSTAP

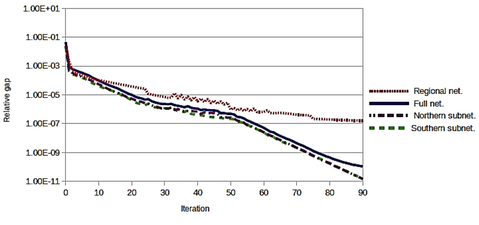
Austin and Texas network results

The Austin network when partitioned into northern and southern subnetworks and solved using DTSAP shows computational savings ranging from 35%-70%, while the Texas network shows higher savings.

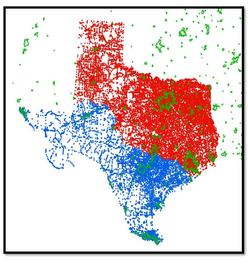


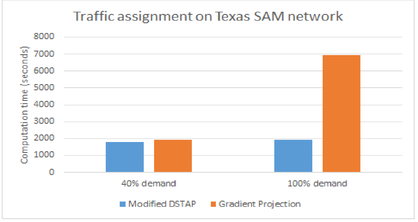


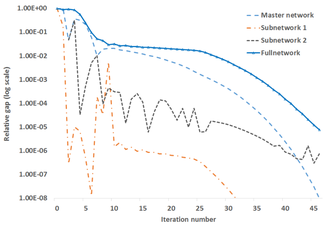
Computational savings of DSTAP algorithm



Relative gap values with iteration showing convergence of the DSTAP algorithm







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CM² Cooperative Mobility for Competitive Megaregions

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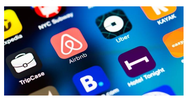
UNIVERSITY OF TEXAS AT AUSTIN
PI(s): Junfeng Jiao
GRA(s): Shunhua Bai

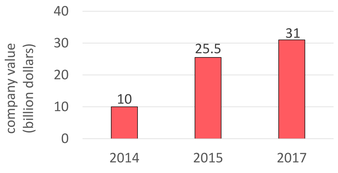
Understanding Airbnb in the United States: An Empirical Study across 40 Cities

Introduction

1. BACKGROUND

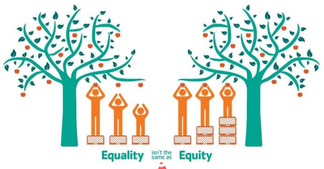
"Sharing economy" can be defined as "an economic phenomenon where consumers grant each other temporary access to under-utilized physical assets (i.e. idle capacity), possibly for money".





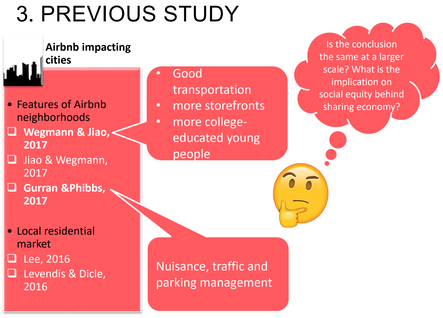
*Source: Airbnb fast fact 2018 and Forbes

2.RESEARCH QUESTION



Is Airbnb one of the bricks on the left or on the right?

3. PREVIOUS STUDY



5. MULTILEVEL MIXED-EFFECT MODEL

Table 1. Multilevel Mixed-Effect Model Description

	Code	Data level	Description
Dependent variable			
Price	LOGP	Census tract	Average price per night per person in logarithmic form
Listing intensity	LOGL	Census tract	Number of listings per 10,000 housing units in logarithmic form
Independent variable			
Demographic and Socio-economics			
Population density	STDPOPDEN	Census tract	Standardized population density
Housing unit	STDHU	Census tract	Standardized housing unit
Housing value	STDHV	Census tract	Standardized housing value
Household income	STDINC	Census tract	Standardized household income
Point of interest	SUSDEN	Census tract	Restaurant, Bar and Pub Density
Location and transportation			
Distance to city center	D2C	Census tract	Average distance from listings at tracts to the corresponding city center in miles
Transit accessibility	TRNSTACC	Census tract	whether the tract is within walkable distance (3/4 mile) from transit stops
Transit frequency	LOGTF	Census tract	Aggregated transit frequency per hour per square mile in logarithmic form
Room characters			
Beds	BED	Census tract	Average number of beds in each listing
Pictures online	PIC	Census tract	Average number of pictures of listings posted online
Reviews online	REV	Census tract	Average number of reviews of listings posted online
Super-host listings	PCTSUP	Census tract	Percentage of super-hosts among all hosts in percent
Star rating	STAR	Census tract	Average star rating (0-5)

6.MODEL RESULTS

Table 4. Results from the multilevel mixed-effect models on listing price and intensity

	log(price)		log(intensity)	
	Coef.	z-score	Coef.	z-score
(Intercept)	3.401***	59.12	3.128***	26.81
Number of people per square mile*	-0.004	-1.11	0.010	1.19
Number of housing unit*	0.046***	6.19	-0.149***	-7.94
Median housing value*	0.055***	9.35	0.137***	9.28
Median household income*	0.167***	17.14	0.363***	14.85
Restaurants etc. density	0.001***	7.12	0.004***	10.31
Distance to city center in miles	-0.017***	-12.83	-0.115***	-33.73
Transit accessibility	0.049***	2.37	0.354***	6.82
Transit frequency in hundreds	0.001***	3.38	0.001	1.73
Mean number of beds	-0.032***	-5.75	-0.001	-0.05
Mean pictures online	0.003***	3.16	0.016***	8.01
Mean reviews online	-0.001***	-4.75	0.001	1.71
Percent of super-hosts	0.0002	1.14	0.003***	4.91
Mean star rating (0-5)	-0.066***	-15.75	0.042***	4.00

Note: * variables are standardized to relative values using equation (3) above accordingly; *** denotes the coefficient is significant under the 0.05 significance level.

FINDINGS

1. AIRBNB SNAPSHOT

Most **Airbnb-friendly** city: Los Angeles (11,108), New York (8,316), Austin (6,934)

Most **Airbnb-intensive** city: Austin (202), Seattle (191), San Francisco (176)

Most **Airbnb-expensive** city: Louisville ($85), Cleveland ($78), Houston ($75)

2. PRICE INDICATORS

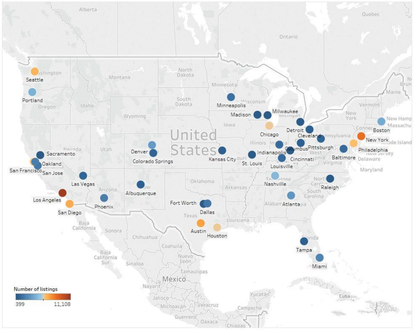
+	−
• Housing unit	• Population density
• Housing value	• Distance to center
• Household income	• Number of beds
• Restaurants etc. density	• Number of reviews
• Transit accessibility	• Star rating
• Transit frequency	
• Number of pictures	
• Superhost percentage	

3. INTENSITY INDICATORS

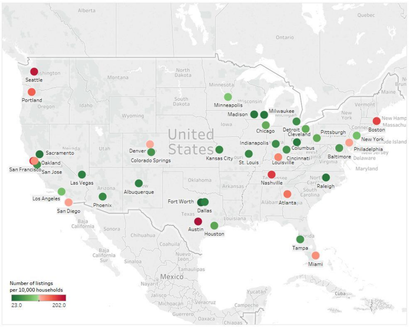
+	−
• Population density	• Housing unit
• Housing value	• Distance to center
• Household income	• Number of beds
• Restaurants etc. density	
• Transit accessibility	
• Transit frequency	
• Number of pictures	
• Number of reviews	
• Superhost percentage	
• Star rating	

4. CONCLUSION

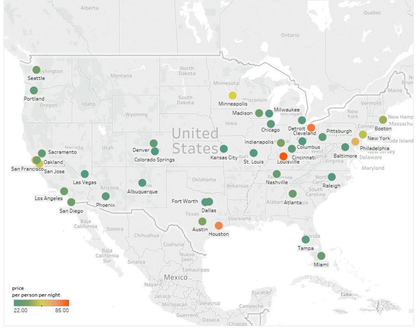
Regression modeling and importance analysis revealed strong correlation between more intensive and expensive listings and neighborhoods with better housing quality, higher income, more amenities and better transportation.



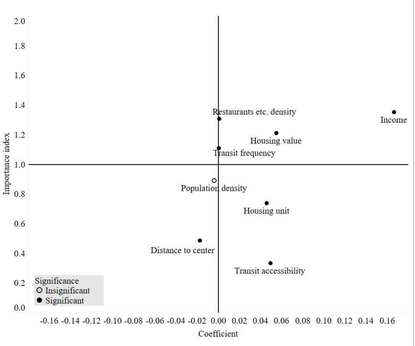
Number of Airbnb Listings by Cities



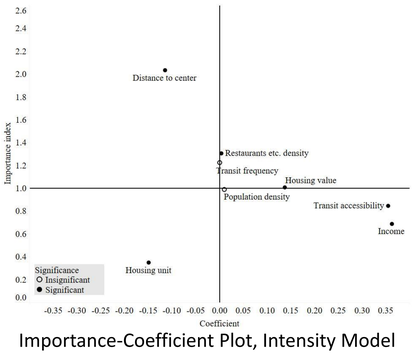
Airbnb Listing Intensity by Cities



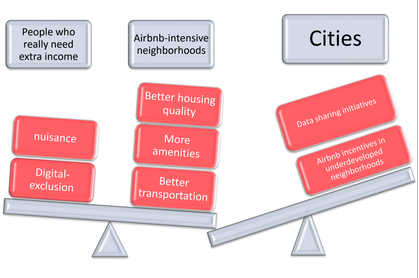
Average Airbnb listing Price by Cities



Importance-Coefficient Plot, Price Model



Importance-Coefficient Plot, Intensity Model



Policy Implication

TEXAS The University of Texas at Austin
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UNIVERSITY OF TEXAS AT AUSTIN
PI: Junfeng Jiao, PhD
GRAs: Chris Bischak and Poyuan Huang

Transit Deserts USA: Further Lessons from 52 Major US Cities

RESEARCH AGENDA

1. BACKGROUND

America's cities are growing faster than ever before. As of 2016 the Census Bureau estimates that over 60% of all Americans live in urban areas. Increasing urbanization present numerous problems, chief among them is the issue of transportation access. This research aims to identify areas where transit dependent populations are being underserved by existing transit networks.

Transit deserts are areas in cities where transportation demand outstrips transportation supply. This concept was first developed by Dr. Jiao at Ball State University. Our previous work has looked at transit deserts in several US cities. This year we have extend this research concept to more cities, conducted additional baseline analysis, and have been working to develop a software product based on this concept.

2.RESEARCH QUESTIONS

This research aims to identify areas where demand for transit exceeds the supply of transit. The primary research question is what areas of cities are being underserved by transportation.

3. RESEARCH CONTENTS

This study uses data from the 5 year 2015 American Community Survey (ACS) to assess the built environment and transportation characteristics of transit deserts. We are using Python modules to create the software product for transit desert identification.

4.RESEARCH FRAMEWORK

Having developed methods to identify transit deserts we wanted to understand if transit deserts were significantly different than non-transit deserts. To do this we identified key infrastructure variables and transportation time variables. We used ACS data and various GIS data to calculate these metrics.

In terms of the software product we used Python and QGIS to develop an open source software product that can detect transit deserts given user specified data. We anticipate this data will be useful for smaller communities conducting transportation planning.

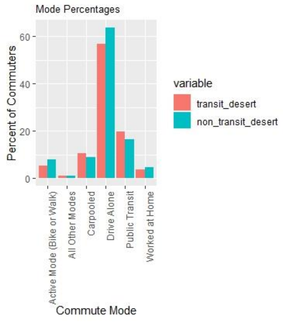
5.TIMETABLE

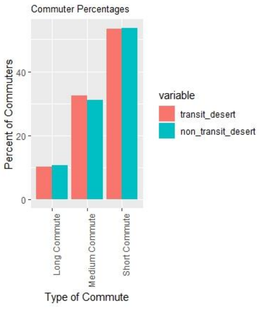
Analysis of transit deserts in 52 cities and baseline analysis has been completed. The software product is in the alpha testing phase. We anticipate the software product to move into the beta testing phase next semester.

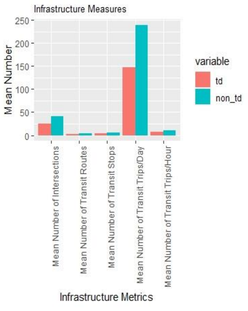
ACHIEVEMENTS

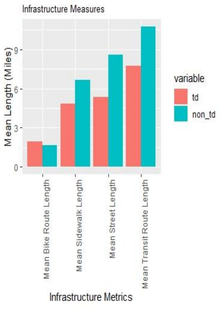
1. Baseline Transit Desert Analysis

We conducted analysis of transit desert areas vs. non-transit desert areas in 52 major cities. We used American Community Survey data and other transportation infrastructure data to assess whether or not people living in these areas had worse transportation outcomes and if they had less access to transportation infrastructure. The results are displayed in the graphs below.





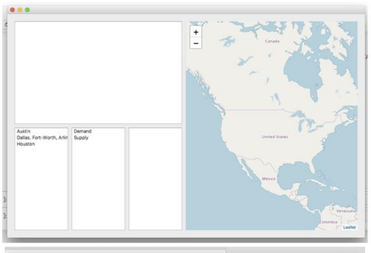




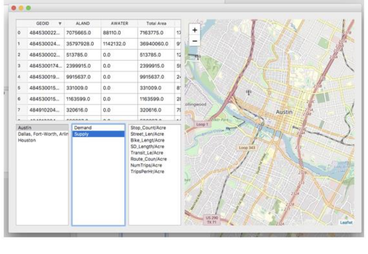
Software Product Development

We used Python 3.6 and various packages to create an interactive transit desert software product. The product allows users to map transit deserts using their data. The user interface consists of three parts. First, one table in the top-left shows the numerical outputs. The second part shows the transit demand or supply and the detailed data which we used to calculate the scores in the city. The last part is the interactive map, in which we show the selected block groups. There are still some functions we are currently working on, such as showing the markers or layers on the map to give users a better understanding about the traffic environment in the selected block groups compared to others in the chosen city.

Default



Click(Austin)



CM² Cooperative Mobility for Competitive Megaregions

Fall Exhibition 2018

UNIVERSITY OF TEXAS AT AUSTIN
PI(s): Junfeng Jiao, PhD
GRA: Chris Bischak
Undergraduate RA: Sarah Hyden

The Role of Transportation Network Companies in Texas Megaregions: Preliminary Results

RESEARCH AGENDA

1. BACKGROUND

Uber and Lyft are playing an increasingly important role in urban transportation systems. However, very little is understood about how and why people use these services, particularly because these private organizations are reluctant to share data with researchers.

Within this context our research team designed and implemented a large scale survey-based project in order to gather information on Uber/Lyft users in the four largest MSAs in Texas, which are Houston, Austin, San Antonio, and Dallas.

2. RESEARCH QUESTIONS

For this project there are three main research questions:

1) How are people in Texas using Uber/Lyft?
2) Why are people in Texas using Uber/Lyft?
3) Are Uber/Lyft enhancing megaregional mobility?

3. RESEARCH CONTENTS

This research primarily consists of data obtain from a large survey of Uber and Lyft users in the State of Texas. The survey was developed by our team in the Urban Information Lab and then circulated internally at the University of Texas.

We then used a panel survey firm QuestionPro to sample 1000 Uber/Lyft users in each of the major Texas MSAs. These MSAs were Austin, Houston, Dallas, and San Antonio.

4. RESEARCH FRAMEWORK

The basic premise for this research was our desire to understand how and why people use Uber and Lyft in the United States. However, given various data limitations we opted for a survey based approach instead. Additionally, given budget constraints we were not able to sample people across the United States so we limited our research to the State of Texas. Finally, because ride-hailing usage is mostly an urban phenomena we limited our search to the four largest MSAs in Texas.

5. ROADMAP

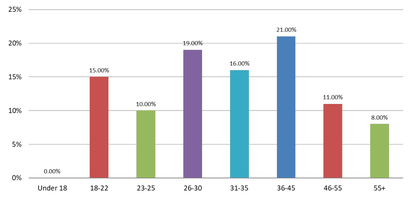
We have completed the survey of Uber and Lyft users in the United States. The second phase of this research we will involve data analysis and modeling using our results from this survey. We hope to extend this research to other shared mobility services like Bikesharing and e-scooter services.

6.TIMETABLE

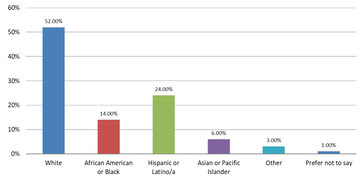
The survey of Uber/Lyft users has been completed as of December 1st 2018. The next steps are to begin data cleaning and analysis which will conducted in the Spring of 2019.

Results of the Survey

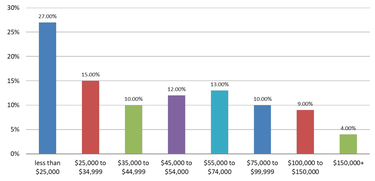
What is your age?



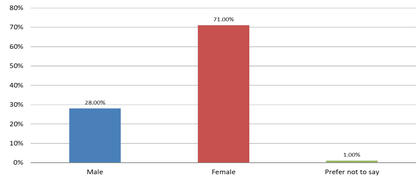
What is your ethnicity?



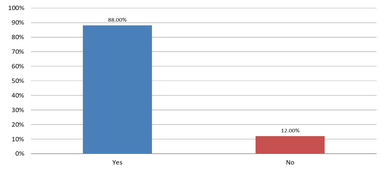
What was your income last year?



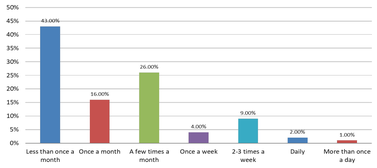
What is your sex?



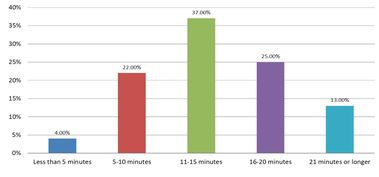
Do you own or have regular access to a personal vehicle?



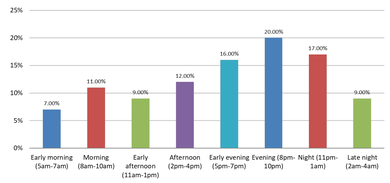
Approximately how often do you use ride-hailing services like Uber or Lyft?



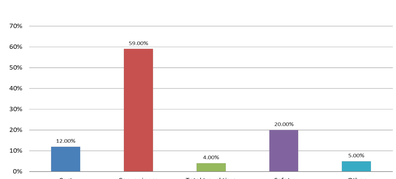
In your estimation, how long is your typical ride-hailing (Uber or Lyft) trip?



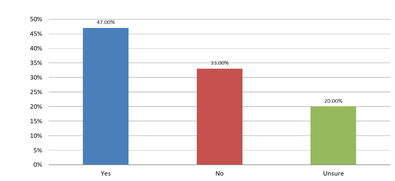
What time of day do you use ride-hailing services like Uber and Lyft? (check all that apply)



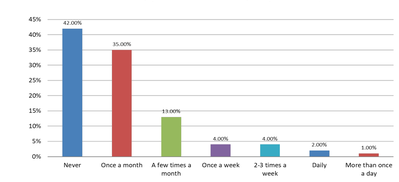
What is your primary motivation for using ride-hailing services like Uber and Lyft?



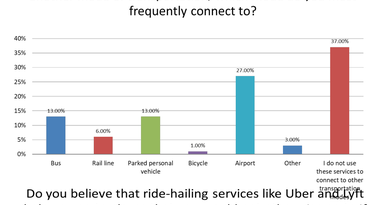
Do you believe you make more trips because of ride-hailing services like Uber and Lyft?



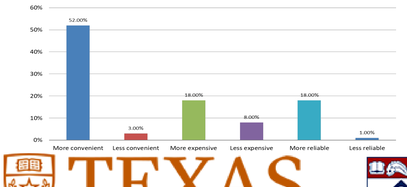
How often do you use ride-hailing services like Uber or Lyft to connect to another mode of transportation (such as a bus, rail line, personal vehicle, airport etc.)?



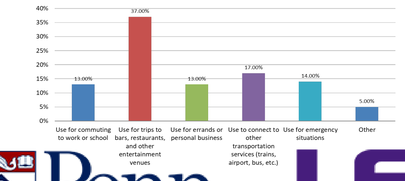
If you use ride-hailing services like Uber or Lyft to connect to another mode of transportation, which mode do you most frequently connect to?



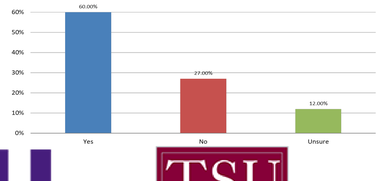
In your opinion, compared to public transit, ride-hailing services like Uber and Lyft are:



Which of the following most accurately describes your usage of ride-hailing services like Uber and Lyft? (check all that apply)



Do you believe that ride-hailing services like Uber and Lyft help you go to places that you would not otherwise go to if Uber/Lyft did not exist?



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UNIVERSITY OF TEXAS AT AUSTIN

PI(s): Kara Kockelman

GRA(s): Yantao Huang, Neil Quarles, Haonan Yan

The Rise of Long-Distance Trips, in a World of Self-Driving Vehicles: Anticipating Trip Counts & Evolving Travel Patterns Across the Texas Triangle Megaregion

1. BACKGROUND

More automated vehicles means easier travel & thus more driving of longer distances. Vehicle-miles traveled (VMT) will rise, throughout US regions, in the coming decades well beyond what trends in population & economic activity would predict (Lee & Kockelman 2018). Texas Triangle Megaregion has 6% of U.S. population, 7% of U.S. GDP, & 7% of U.S. VMT.

Long-distance travel (here) means **trips over 50 miles** one-way. 43.2% of Person-mile traveled is LD in U.S. with 28% of leisure, 25% of visiting friends and relatives, 18% of business, 15% of personal business and 12% of commute.

2. RESEARCH MOTIVATION

Connected & (fully) automated vehicles (CAVs) may change long-distance travel, by shifting travel towards CAVs (& away from conventional vehicles & air travel), along with longer & more frequent trip-making by travelers of all types (including those currently unable to drive). A key reason for preferring an AV comes from lower "driving" burden, so a lower perceived value of travel time en route (for those who use to drive).

How much more VMT will the Texas Triangle experience, by passenger vehicles and heavy trucks moving freight?

3.RESEARCH FRAMEWORK

This project calibrated models of destination, mode & route choice for passengers & freight, and simulated those behaviors across Texas, with AV & ATruck options. Results were pulled out for the Texas Triangle specifically.

4. CONTRIBUTION TO PRACTICE

This work is the first of its kind to assess what types of policies, strategies & models may be necessary to facilitate the efficient introduction of CAVs, shared automated vehicles (SAVs) & Automated Trucks (Atrucks) across the US & its megaregions, without compromising congestion & mobility. Policy recommendations are now being developed to reduce any negative effects caused by AV implementation & invest scarce resources into optimal locations & practices.

5.DELIVERABLES

A final report is due in March 2019, & an article is under review for publication in the *Journal of Transport Geography.*

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RESULTS

1.Data Set

The megaregion's 66 counties' come from the regional boundary used by Zhang et al. (2007), and associated network and traffic analysis zone (TAZ) files were obtained from the Texas SAM. The megaregion contains 2,160 of the state's 4,667 TAZs. The SAM network covers all of North America (200,445 links and 168,507 nodes), with greater detail in and near Texas (19,549 nodes and 27,976 links), allowing for travel outside the region, especially with very heavy traffic conditions.

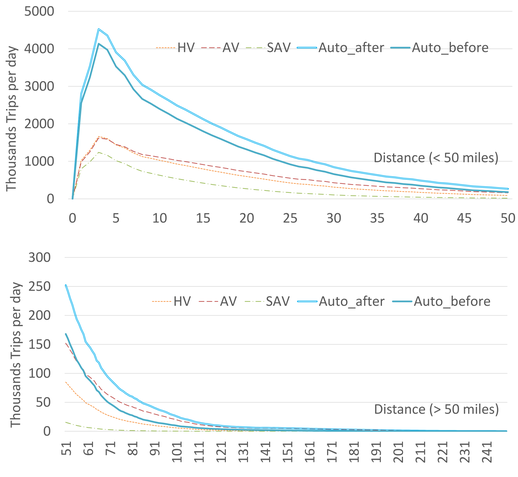
2. Model Built & Simulation

The project team assembled parameters in four-step model in TransCAD with Statewide Analysis Model (SAM) data, & anticipated the impacts of AVs', SAVs' & Atrucks' impacts on destination, mode & route change choice . A travel demand model with feedback is implemented to forecast changes in vehicle-miles traveled (VMT), congestion, & travel patterns across the megaregion.

3. Applications

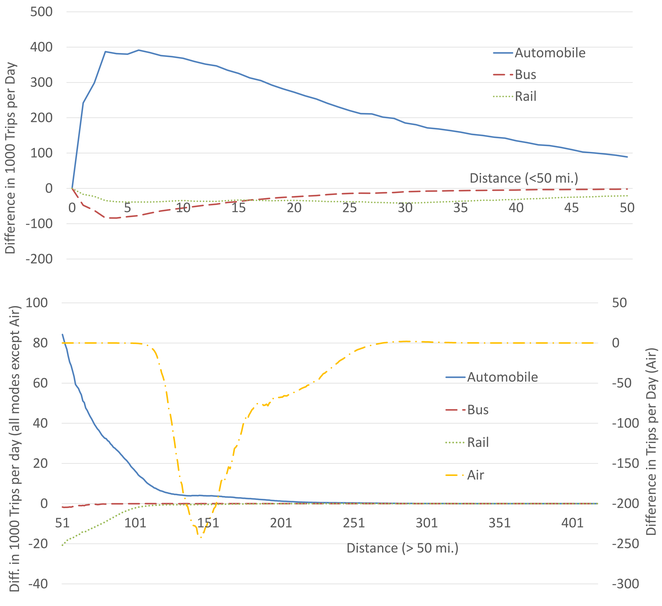
This work assumes a 15% increase in Year 2040 trip generation rates due to AV technologies enabling new trip-making. Destination TAZs attraction depends on a logsum across mode options and destination's population. When automated modes are added to the set of alternatives, HVs, AVs and SAVs are nested under the Auto mode; Htruck and Atruck are nested under the Truck mode. Both AVs and HVs carry operating costs of $0.60 per mile, and SAVs cost either $1.50, $1, or $0.50 per mile

Passenger Trip Distribution



Mode Choice (Distance < 50 mi. & > 50 mi.) – 2040 Scenario

30% VOTT reduction for AV, Nesting Coefficients = 0.6



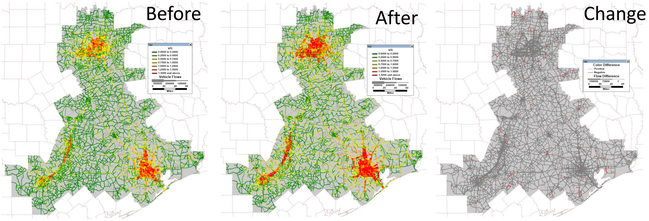
Mode Shifts vs. Base Case (No AVs)

Mode		Automobile	Bus	Rail	Air
Trips before	< 50 miles	64,678 k/day	1,837 k/day	2,219 k/day	N/A
Trips after		75,088 k/day	623.8 k/day	642.3 k/day	N/A
Change		+16.1%	-66.1%	-71.1%	N/A
Trips before	> 50 miles	2,946 k/day	33.64 k/day	988.2 k/day	14.27 k/day
Trips after		6171 k/day	2.416 k/day	595.7 k/day	2.497 k/day
Change		109.5%	-92.8%	-39.7%	-82.5%
Total change		+20.2%	-66.5%	-61.4%	-82.5%

VMT Changes vs. Base Case (No AVs)

Area	Before (per day)	After (per Day)	Change
Dallas-Fort Worth	453M miles	669M miles	+47.7%
San Antonio	118	171	+45.8%
Houston	119	186	+56.9%
Austin	432	587	+36.0%
Megaregion	1,367	2012	+47.2%

Congestion Change



Top Truck Trip Increases by Commodity

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UNIVERSITY OF TEXAS AT AUSTIN
PI: Lisa Loftus-Otway
GRA: Alexander Hunn

Using State Government to Mitigate the Effects of Bracketing on Multijurisdictional Transportation Planning

RESEARCH AGENDA

1. BACKGROUND

As the American population grows and becomes ever more interconnected across jurisdictional boundaries, transportation authorities need a streamlined, predictable framework of laws to make effective policy.

- The federal system of the United States emerged from a hotly contested debate about the role of the federal government, and the need for local autonomy which coalesced into the government we have today.
- Notably absent in the federal constitution, however, is any enumerated protection for the powers of local governments. As a result of this absence, any and all delegation of power to these smaller governments can be found only in the myriad state constitutions.
- In addition to the delegation of powers, which varies by state, nearly every state constitution has a form of restriction on "special" or "local" legislation (known as bracketing). That is, legislation targeted at one particular area or jurisdiction in the state, requiring state law to affect all members of a given class equally within the state.
- Interpretations of these provisions by courts have varied, and states have managed to circumvent court rulings effectively.
- Part of the problem may be a lack of substantial interest in litigating these issues. Special treatment of individual classes and locales can frequently benefit them. The harms of this sort of legislation is anticipated to be disbursed more widely, by those outside the bounds of any given bit of special legislation or, who would benefit from a planning perspective from conformity between jurisdictions. One way to improve the situation is to give additional force to existing Constitutional provisions against special legislation.
- Transportation law in many states has become highly inconsistent between jurisdictions, making cooperation more challenging In transportation, bracketing has been used to restrict the activities that transit agencies can conduct, and some would argue stymie efficient multimodal transportation options.
- Bracketing has specifically and substantially affected Texas transit policy by setting different rules for different municipal transit authorities.
  - For example, chapter 451 Texas Transportation Code sets specific policies for Capital Metro, the transit agency which serves the Greater Austin area. However, Texas Transportation Code at Chapter 451 does not mention "Capital Metro" or "Austin" specifically. Instead, it uses the classification of a "transit agency confirmed before July 1, 1985 with a population less than 850,000
- Commuting maps (Figure 1) also show that we are travelling within and between megaregion areas. Providing options to facilitate a multi-modal commuting choices in planning and funding, by reducing bracketing could provide multiple transportation agencies opportunities to more easily collaborate.

2.RESEARCH QUESTIONS and FRAMEWORK

This project will determine the extent to which these prohibitions have been applied by courts, investigate their applicability to transportation planning, and explore legal arguments that could be made in the future to use these provisions to facilitate multijurisdictional transportation projects.

This project will use primarily legal research to interpret constitutional and statutory text alongside case law interpreting this text and will:

- Review provisions within selected the Texas Triangle, Cascadia and North East megaregions' state constitutions, legislation and regulations, and litigation surrounding bracketing.
  - Three megaregions compared within a matric to determine differences and similarities and map breadth and effectiveness in restricting efficient multi modal mobility options.
  - Provides a comparative review of the effects of different levels of restriction.
- Conduct a critical legal analysis of case law on bracketing.
- Develop recommendations for effective megaregional/inter jurisdictional multimodal planning.
  - Legal and policy recommendations
  - Juridical recommendations for interpreting provisions to facilitate smart transportation policy
  - Develop suggestions for how these issues could be reconciled legislatively

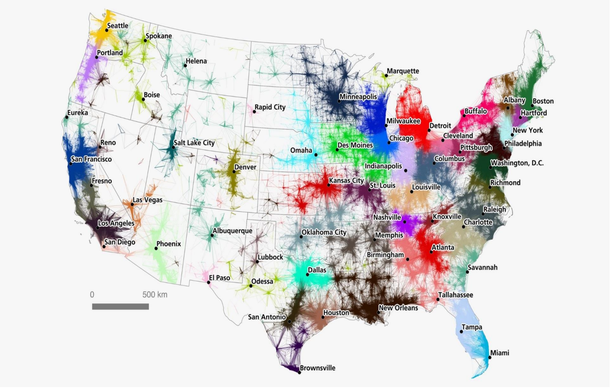

Figure 1: Commuting Maps in the U.S. Reveal we All Live in Megaregions Not Cities.
Source: Aarian Marshall, Wired, 2016

Work To Date

Findings from Texas

- Texas has a long history of bracketing in legislation.
  - Article III, Section 56 of the Texas Constitution provides that "the Legislature shall not, except as otherwise provided in this Constitution, pass any local or special law," regarding a list of subjects, as well as prohibiting the passage of any local or special law in any case where a general law can be made applicable.
    - The section treats equally local laws, which are those limited to a specific geographic region of the state, and special laws, those limited to a particular class of persons. See Maple Run v. Monaghan, 931 S.W.2d 941, 945 (Tex. 1996).
    - The restriction is intended to focus the efforts of the legislature on the public interest by preventing the advancement of personal projects.
  - The Texas Supreme Court has weighed in on the issue, saying that a law is not prohibited "merely because it only applies in a limited geographic area." However, the legislation "must be broad enough to include a substantial class and must be based on characteristics legitimately distinguishing such class from others with respect to the public purpose sought to be accomplished by the proposed legislation."
  - While the Texas Supreme Court has sometimes given force to the special legislation clause of the Texas constitution, many statutes remain in full force despite a lack of compliance with these standards.
  - In Texas, the "ultimate test of whether a law is general or special is whether there is a reasonable basis for the classification made by the law, and whether the law operates equally on all within the class." Rodriguez v. Gonzalez, 148 Texas 537, 540 (Tex. 1950).
    - A special law is one which makes a classification "not based upon a reasonable and substantial difference in kind, situation or circumstance bearing a proper relation to the purpose of the statute. To make this determination, the court relies on a two-part test. See Robinson v. Crown Cork & Seal Co., 335 S.W.3d 126, 189.
    - The first part compares the purpose of the legislation to the delineated class; if the delineated class encompasses only a fraction of those the legislation could affect consistently with its objectives, the classification likely has no rational relation to the purpose of the statute. Id.
    - The second part examines whether similarly situated parties are treated similarly, or arbitrarily excluded by the statute. Id. at 189-90.
    - Maple Run reiterated the Rodriguez test, listing examples of what sort of specifications reasonably delineate a class, and what sort don't. The court focused in on population, the factor most frequently used by the Texas Legislature to bracket legislation. Statutes applying only to counties or municipalities within a population range tend to be impermissible, particularly when the range is very small. By contrast, statutes merely specifying a minimum population tend to be upheld.
    - For example, applying a state tax law only to counties with population between 125,000 and 175,000 (affecting only a single county) was held an unreasonable classification. See Miller v. El Paso County, 150 S.W.2d 1000, 1001 (Tex. 1941). By contrast, imposing special bail bond restriction in only counties with greater than 150,000 people was based on a reasonable determination that they were only helpful in populous areas. See Robinson v. Hill, 507 S.W.2d 521, 524 (Tex. 1974).
  - Lack of standing may explain why many bracketed Texas laws remain in force, despite failing the Rodriguez test. Especially in the case of transportation, it can be difficult to draw a straight line between bracketed provisions and the harms they cause.
  - What does this mean?
    - Jurisdictional complexity and legal inconsistency between jurisdictions burden transportation planners ability to effectively plan for mobility and impact commuters who rely on them to provide network efficiencies.

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PI: Lisa Loftus-Otway
GRAs: Paulina Urbanowicz-Pollock; Roxanne Lin

Inter-regional Resiliency: The Role of MPOs in Natural Disaster Planning and Response Preparation.

RESEARCH AGENDA

1. BACKGROUND

Natural disasters increasingly wreak havoc on communities, regional economies and transport systems, impacting communities across the United States and the world. Achieving the goal of megaregions to increase economic competitiveness will depend in part on the resilience of multiple economically connected regions to natural disaster events. This study seeks to better understand the economic impacts of natural disasters on MPOs and surrounding regions, and to identify potential opportunities to increase resilience from a financial and transportation infrastructure perspective.

2.RESEARCH QUESTIONS

Should transportation resilience planning be done at the megaregion level, or should this effort be led by the state?

Do connected MPOs have a vested interest in the recovery or success of MPOs in typically geographically vulnerable locations?

What opportunities exist to integrate resilience planning into the MPO planning cycle?

3. RESEARCH CONTENTS

As the American population grows, intensifies, and becomes ever more interconnected across jurisdictional boundaries, transportation authorities need a streamlined, predictable framework to make effective policy. This research will outline existing processes and funding sources accessible to local agencies after a natural disaster event, and will develop a framework to conduct economic analysis at a megaregional scale. It will also identify recommendations to increase megaregional economic resilience to natural disasters.

4.RESEARCH FRAMEWORK

This study seeks to evaluate trade-offs between the factors that contribute to the vulnerability to natural disasters of a region, and subsequently an entire megaregion. It seeks to identify opportunities for regions and MPOs to incorporate practices that will ultimately contribute to increased economic resilience for funding transport infrastructure in megaregions in the future.

Additionally, this study evaluates how economic impact is calculated after a natural disaster, and provides a proof of concept for developing an estimate for economic impact at the megaregional level.

5. ROADMAP

The first semester of this project is focused on collecting data and understanding how different agencies and entities quantify economic impact after a natural disaster. This includes developing an understanding of the funding request process that local agencies go through to obtain federal funds. Identifying different key players in providing funding sources is critical to understanding how different types of transportation infrastructure are served in the wake of a disaster incident.

The project will develop a proof of concept for an economic analysis to be conducted at a megaregional scale. It will also synthesize best practices in transportation resilience planning and develop recommendations for the Texas Triangle megaregion.

6.TIMETABLE

The initial stage of this project includes information collection of natural disasters impacts on transportation systems and estimated cost; best practice research on planning for resilient transportation infrastructure, and interviews to identify opportunities to improve resilience planning for megaregions. Fall 2018: Data Collection. Spring 2019: Synthesis and testing application of identified recommendations.

ACHIEVEMENTS

1. Natural Disasters

The number of natural disaster incidents has rapidly increased in the last two decades. Impacts of natural disasters, however, not confined to one region. This research evaluates different types of natural disasters including impacts of hurricanes, tornados, floods, snowstorms and wildfires to identify impacts on transportation infrastructure, and potential funding sources available to repair transportation assets.

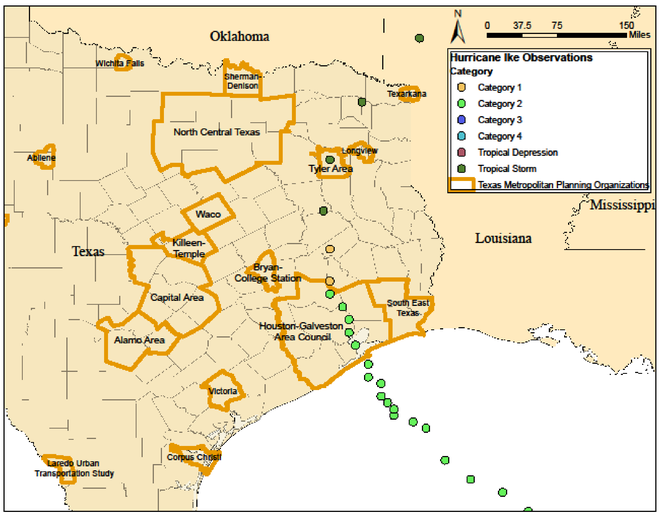
2. Economic Impact

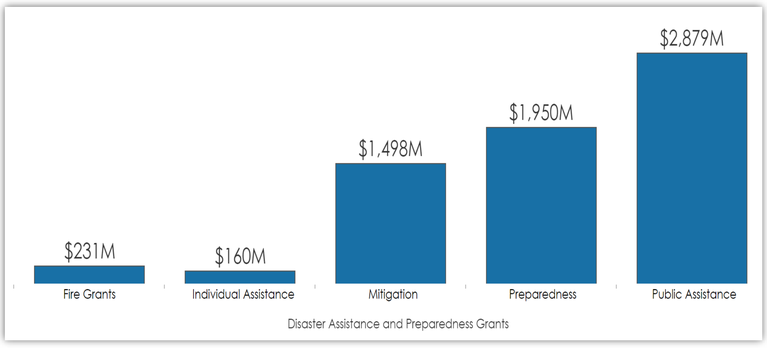
Economic impact of a natural disaster is identified by local and state governments when applying for federal funding for repairs, and to estimate …

Since 1953, the state of Texas has experienced 255 federally declared disasters. The events with highest number recorded include fire, flood, hurricane, severe storm, and tornado. 2011 was the year with highest number of declarations on record within the span of 64 years.

3. Planning for Resilient Transportation Systems: Best Practices

U.S DOT has identified best practice examples of planning for resilient infrastructure systems. Examples include combining multiple types of funding sources, state officials enabling local officials to respond to emergency situations faster, and proactively planning to improve transportation infrastructure prior to an incident.





Source: https://www.fema.gov/data-visualization-summary-disaster-declarations-and-grants

California

- Storms, Floods, Landslides
- California Transportation Commission signed a resolution enabling state transportation agencies to access funds post-disaster in advance of a commission meeting, in support of addressing emergency improvements in whole instead of piecemeal.

Iowa

- Floods, Tornadoes, severe thunderstorms
- Preparedness and recovery plan was in place prior to natural disaster event: led to efficient and faster transportation system recovery.

Louisiana

- Hurricanes
- Proactively fixed and improved vulnerable roadway with more resilient and sustainable materials.

Wisconsin

- Flood
- Combined transportation system recovery and economic development efforts to increase funding sources

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PI(s): Sandi Rosenbloom
GRA(s): Sagnika Das, Aaron Sessions

Creating Neighborhood Walkability Metrics to Represent the Needs of Older People

RESEARCH AGENDA

BACKGROUND:

Over 75% of US seniors live in low density neighborhoods with few places to which they can safely walk yet seniors walk for an increasing share of all trips as they age. There are multiple guides and metrics to measure and promote neighborhood walkability but many either miss issues important to seniors OR emphasize elements that might serve younger people but are actually viewed by seniors as barriers to walking. Most existing walkability guidelines and indices also do not link directly to specific infrastructure improvements and supportive programs; they merely measure deficiencies.

OBJECTIVES:

- Synthesize useful and powerful walkability metrics that directly address the needs, resources, and perceptions of older people;
- Develop a concise typology of focused metrics that allow planners to effectively identify the barriers to walkability for seniors;
- Link neighborhood deficiencies identified by these metrics to specific policy and infrastructure solutions, allowing planners and seniors to advocate for targeted neighborhood changes.

APPROACH AND METHODS:

- Review, evaluate, and synthesize the body of interdisciplinary literature on how seniors view the walkability of their neighborhoods, the reasons why they walk, and the improvements they seek to facilitate additional walking.
- Identify, compare, and contrast major existing walkability indices and metrics, determining how well they include the elements of walkability that respond to senior needs and concerns and avoid those that create barriers to walkability for seniors.
- Conduct multiple focus groups with diverse seniors in the mega-region to assess their perceptions of neighborhood walkability.
- Develop a concise set of powerful metrics capturing the most relevant and important features of the built environment supporting walkability for diverse seniors.
- Link deficiencies in neighborhood walkability for seniors to actionable policies, improvements, and programs.

TIMELINES: Fall 2019 Completion

ACHIEVEMENTS

Barriers to Senior Walkability Discussed in the Literature

Physical Barriers

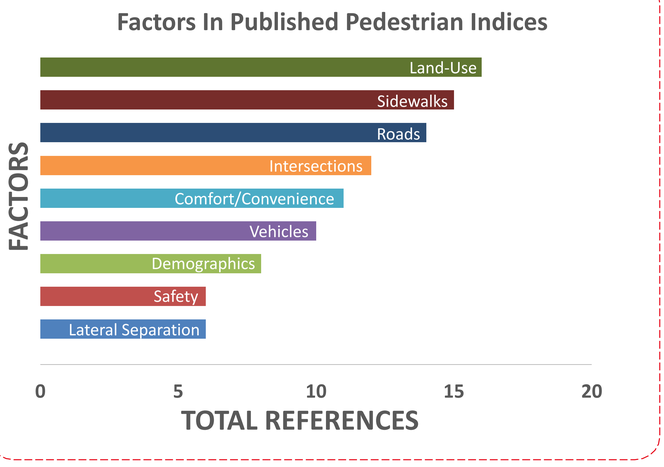
- *Multiple Intersections* – Seniors fear that drivers making turns will hit them; seniors often avoid intersections and cross mid-block believing it is safer when it rarely is.
- *Driveways and parking lots* – seniors fear being hit by vehicles since many destinations require them to walk through parking lots.
- *Abundant vegetation, trees* – seniors who fall risk serious injury and even death; they avoid protruding tree roots, fallen leaves, and overgrown shrubs and vegetation even if these features are otherwise attractive .

Psychological Barriers

- *Graffiti and litter* – Seniors see these elements as signs of crime and social disorder.
- *Unkempt yards, overgrown vegetation* – Seniors avoid walking where their sight lines are restricted or they fear criminals can hide.
- *Busy, bustling crowds* – seniors often avoid places with rapidly moving people, dogs, bikes, or children in fear of falling or victimization.
- *Strangers and young people* – seniors are often fearful of the unknown and worried about both their personal safety and security.

Conflicts in Walkability Metrics

Many walkability metrics focus on the needs of younger travellers walking for ***transportation,*** that is to specific destinations. Seniors tend to walk for recreation, to socialize, for physical activity, and to maintain a connection to their neighborhood; they may have no set destination or the destinations are incidental. Walkability metrics should acknowledge senior walkability needs and perceptions by identifying: 1) those needs and desires they share equally with others; 2) those that they value very differently, and 3) those factors and situations sought by other travellers that seniors find difficult or frightening.



Missing the Mark

The above figure synthesizes the major elements that twenty-five (25) walkability studies and indices stress. The ones stressed the least, Safety and Lateral Separation, are ones often most important to seniors. The reverse is also true; elements stressed most often, Land-Use and Sidewalks, are often less important to seniors.

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PI: Dr. Sandi Rosenbloom
GRAs: Kyle Smith, Aaron Sessions

USING TECHNOLOGICAL INNOVATIONS ACROSS THE MEGAREGION TO ENHANCE THE MOBILITY AND ACCESS OF SENIORS

1. BACKGROUND

America is aging rapidly; by 2025 almost 80 million Americans will be over 65. Seniors will constitute more than 20% of the population, outnumbering children for the first time in history. Many will remain in the paid labor force long after the traditional age of retirement; 40% will likely work full time until the age of 75. Seniors will also account for almost one out of four drivers on US highways because most will live in inherently low density places with few alternatives to the car. Yet many seniors will want or need to curtail or cease driving with few practical alternatives, forcing many into driving when they should not or doing without crucial human, social, and medical services.

2.RESEARCH QUESTIONS

- Will new technology and key aspects of the shared economy meet some senior mobility needs across a megaregion?
- Will internet and technological resources reduce the need for travel by seniors with decreasing ability to drive?
- Do shared ride platforms and other forms of the shared economy provide a realistic mobility option for seniors in suburban and rural areas?

3. RESEARCH CONTENTS

Our research consisted of two pilot groups with 11 total participants. As of early June, we have talked to 79 participants in eight focus groups, and are using questionnaire data from these groups in our research. There are some important aspects to this group's demographics:

- Individuals were between 68 and 98 years old
- We spoke with 83 women and 7 men
- 14 individuals are married/partnered
- 84% of our participants still drive

4.RESEARCH FRAMEWORK

This is a qualitative research effort, assessing how much seniors from diverse backgrounds know about, use, or would consider using a range of technological innovations and various services offered by the private firms, and the extent to which they knew about such services, used them, or would consider using them in the future if they had mobility needs.

5. RESEARCH RESULTS

Do you now, or have you ever used...	Yes	% of respondents who answered yes (79 total)
Local home grocery delivery	4	5.1%
Local delivery of other products	2	2.5%
Meal kit services	2	2.5%
Local restaurant delivery services	2	2.5%
Local Transportation Network Services	3	3.8%
On-line purchase of groceries and supplies	6	7.6%
On-line purchase of clothing	4	5.1%
Local chore/task services	0	0.0%

All questions included a number of examples and company names.

6.TIMETABLE

The project will be completed by July 1, 2018

ACHIEVEMENTS

1.Literature Review
Conducted a literature review and evaluated socio-demographic data on the use of the shared economy and emerging technologies by seniors.

2. Graduate Seminar
Structured a graduate seminar in the University of Texas at Austin Community and Regional Planning Program.

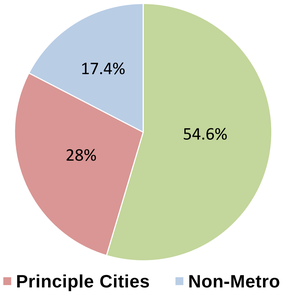
3. Focus Groups
Conducted a series of focus groups with almost 100 diverse seniors living across the Austin Metropolitan area.

Focus Group Research

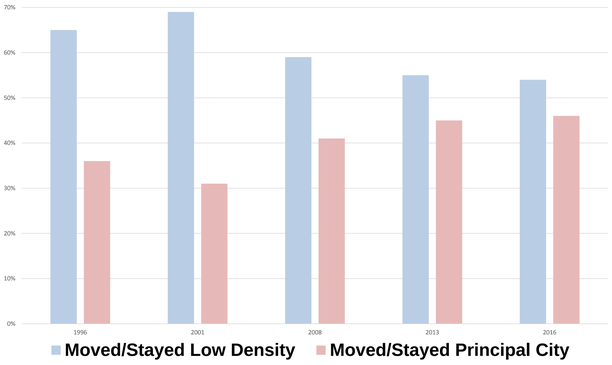
What Participants Knew
- Many participants had not heard about most of these services
  - Men were more likely to know about and have used some services
- There were many misconceptions about what services were/did
- There was some interest in learning more as discussions progressed

Common Discussion Themes
- No internet or smart phone experience
- Unwilling to give credit card info
- Reluctance to pay for services they could do themselves
- Paying for local transportation seems a strange/foreign idea
- Fear of strangers coming to or entering the house (bringing groceries, etc)
- Fear of drivers in TN services
- Concerns about quality, ease of returns

Where Seniors Live (2016)



65+ Movers Who Stayed in Same Metro Area



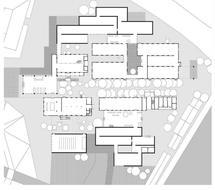
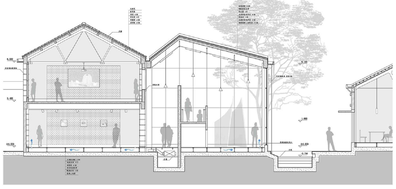
Seniors Who Moved 2015-2016

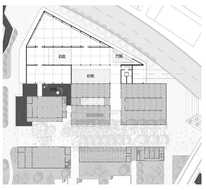
3.2% of seniors moved **4.3%** of all people that moved that year were seniors

They Moved to or Stayed In

Suburbs	A Principle City	A Non-Metro Area
55%	32%	13%

Two moved "out" for every one that moved "in"

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CM² Cooperative Mobility for Competitive Megaregions

Fall Exhibition 2018

UNIVERSITY OF TEXAS AT AUSTIN

PI(s): Dr. Gian-Claudia Sciara, Dr. Michael Walton
GRA(s): Rydell Walthall, Paulina Urbanowicz-Pollock, Mashrur Rahman

How Does Regional Transportation Governance and Capacity Influence Investment Outcomes?

Creating a Robust Dataset for MPO Research

RESEARCH AGENDA

1. BACKGROUND

Regional and megaregional transport systems enable the economic and social interactions that make metro regions significant engines of growth and innovation. Governance of our regional scale transportation systems attracts limited attention from researchers, however.

One persistent research challenge is the lack of readily available data about the organizations responsible for regional transportation governance. Federal transportation law requires that urban areas have a state-designated metropolitan planning organization (MPO) to coordinate transport planning and spending for the region. The MPO is usually governed by an appointed board, most members of which hold local elected offices in the region. Members and staff work together on MPO committees to advance plans for the region. To receive federal transport dollars, the MPO must approve a short-range Transportation Improvement Plan, or TIP—a capital program identifying federally funded projects in the region—and a long range plan on which the program is based. The MPO uses travel demand models to anticipate its future needs and evaluate potential investments.

2.RESEARCH QUESTIONS

This research sets the stage for a series of explorations into the influence of regional (and megaregional) transportation governance and capacity on transportation investments and outcomes. The project develops a database capturing key MPO governance variables. For instance, it asks whether transit agencies and airport interests are represented on the board, what MPO committees exist for non-auto modes, and what its travel model capabilities are. It also asks whether MPO decisions on flexible federal funding favor transit or not.

3. RESEARCH CONTENTS

The database includes information that indicates transit agency and airport representation in comparison to total board composition; whether or not MPOs have standing committees or advisory groups for active transportation, airport or transit; and the type of travel demand models currently used by MPOs. Other information includes if board representation in MPO areas is weighted, and modes currently modeled by travel demand models used.

4.RESEARCH FRAMEWORK

Initial stages of this research project include determining the most informative and objective variables accessible through MPO websites and travel demand model documentation. After establishing necessary variables, the database can be used to investigate indicators of board composition, transit representation, airport representation, and advancement of travel demand modelling.

5. ROADMAP

The research is collecting robust baseline data on MPO governance. All relevant information is assembled by consulting MPO websites and information on board membership, as well as data on transit operators from the National Transit Database. In addition, data from the Government Accountability Office has been collected to identify flexible funding transfers favoring transit in metropolitan areas. Finally, data on transit operators' MPO participation will be merged with flexible funding data and used to explore and model the relationships between transit operator involvement in MPO decision-making and relative extent of flexible funding transfers.

ACHIEVEMENTS

1.MPO Board Composition History and Hypothesis

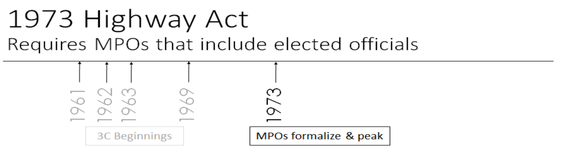
The first MPO's were designated in the 1960's with the beginning of comprehensive, coordinated, and continuous regional transportation planning in the Federal Aid Highway Act of 1962. Every urban region with more than 50 000 people is required to be served by an MPO, and there are currently 404 MPO's across the country. MPO's control regional access to federal transportation project funding, but the governance structures of MPO's vary substantially. This research hypothesizes that MPO's with voting or committee representation for non-automobile modes will provide more flex-funding for non-automobile projects. To test this hypothesis, the research has focused its first stage on creating a first-of-its-kind comprehensive database of MPO governance structures.

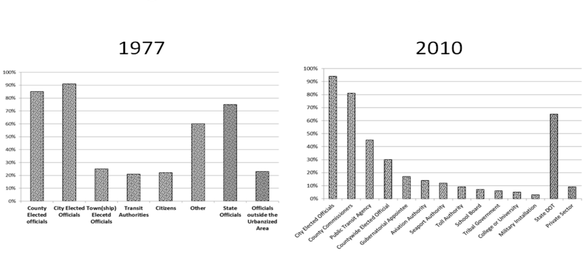
2. Database Creation Process

The project explored the possibility of alternative methods--like surveys--for developing a robust baseline data on MPO research. Consulting MPO websites was preferred as the most viable option to assemble the wide range of available information. The team followed an iterative process to determine relevant variables. The variables chosen for the database were narrowed based on prioritizing consistency. The method then tested among researchers to ensure the uniformity of the responses. Along with the websites--MPO bylaws, MoUs, Long Range Transportation Planning report and modelling documentation were also reviewed carefully for more nuanced information such as voting structure, whether a transit agency is represented directly or indirectly on the MPO board, the modelling approach used, and whether or not agencies participate in MPO technical advisory committees, or other task forces or forums.

3.Preliminary Results

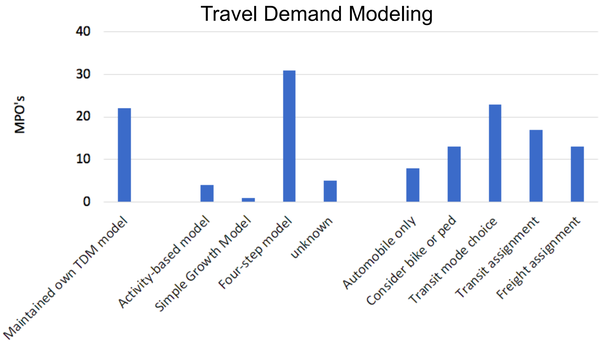
With the MPO data already compiled in the database, it is possible to start looking at common trends. Overall, there are not strong relations between region population and board size, although the very large boards (greater than fifty members) do seem to only occur in very large metropolitan areas (over a half million people). As might be expected, the vast majority of MPO's are using the classic four-step model.



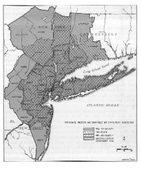
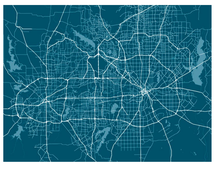


MPOs (%) with Board Seat for this Participant

Based on 41 MPOs (~10%), 3-5 from each 10th percentile		
Average Voting Members:	15.6	Ranges from 3 to 112
Weighted Avg Voting Members:	24.5	
	MPOs	%
Has Voting Transit Representation	13	32%
Airport Committees	0	0%
Pedestrian or Bicycle Committees	9	22%
Transit Committees	2	5%



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UNIVERSITY OF TEXAS AT AUSTIN
PI(s): Ming Zhang
GRA(s): Liang Chen

High Speed Rail Demand Forecast for Texas Triangle: Demographic, Commute and Industries

RESEARCH AGENDA

1. BACKGROUND

The idea of High Speed Railway(HSR) can date back to 1965 when High Speed Ground Transportation Plan was published. In 2009, Federal Railroad Administration published Vision for HSR in America where they identified 10 railway corridor for future HSR development. Early this year, Texas Central Partner has announced that they have secured up to 300 millions of loans and Tim Keith, the CEO of Texas Central also affirmably express the confidence in building the bullet train between Houston and Dallas by saying that, "The bullet train is for real, and we're moving out to 2018 with a big boost of energy."(Hethcock, 2018)

2.RESEARCH TASK

Explore alternative models other than conventional 4-step modelling that best reflect the inter-region travel demand in the Texas Triangle.

a. The historic and future trends for the Texas Triangle of demographic changes and economic development.

b. Mode Share of Mega Travel and Intra-metropolitan travel.

c. Estimating travel demand for HSR in the future under different scenarios?

3. RESEARCH CONTENTS

The research would find new method to incorporate demographic, economic and transportation data into inter-city short and long distance trip generation.

Building upon the modeling method developed by Cambridge Systematics for California HSR ridership model, we will adjust the model to fit into Texas setting.

4.RESEARCH FRAMEWORK

Required data: US Census Bureau Population and Population Projection; Commute Patterns; County Business Patter; Air Travel Flows; Freight Analysis Framework(FAF)

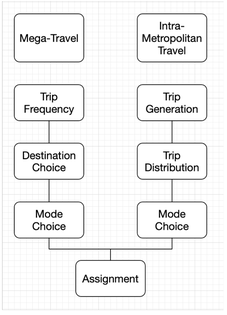
We will update the parameter for Travel Time Budget, Travel Money Budget and Model Share by Zhang and Chen(2009) by applying Texas social and travel data into the model.

$$\frac{TV}{cap} = \log\left(\frac{GDP/cap}{g} - h\right) * \left(\frac{GDP}{cap}\right)^{e} * f^{*}$$

$$f^{*} = \frac{240{,}000^{1-e}}{\log\left(\frac{240{,}000}{g} - h\right)}$$

Where TV is the total traffic volume per capita f^{*} accounts for the travel cost and inverse unit cost of transportation and the log stands for dimensionless quantity.

5. ROADMAP



6. Next Step

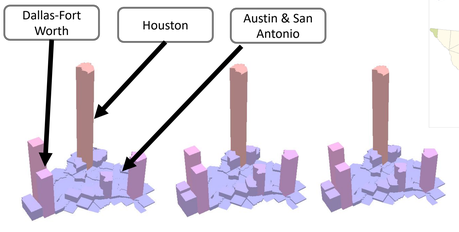
Develop the Travel Time Budget, Travel Money Budget and Mode Share Model using the data collected and explore the mode share for Mega-travel and Intra-metropolitan Travel.

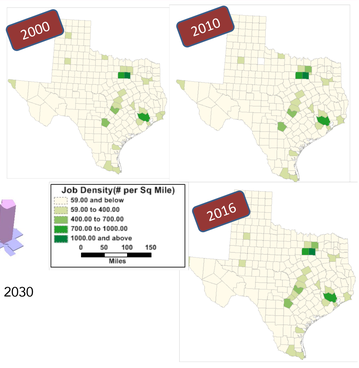
ACHIEVEMENTS

1.Demographic and Economic Trends in Texas Triangle

Population for the Triangle has grown by 82.9% since 1990. From the total population prism maps, it is clear that corridors between Houston and Dallas, Dallas and Austin are growing at an expedited speed. By 2030, the population would exceed the 20 million cap, reaching 20,263,702.

Job Density data analyzed also conforms that the corridors have absorbed jobs.

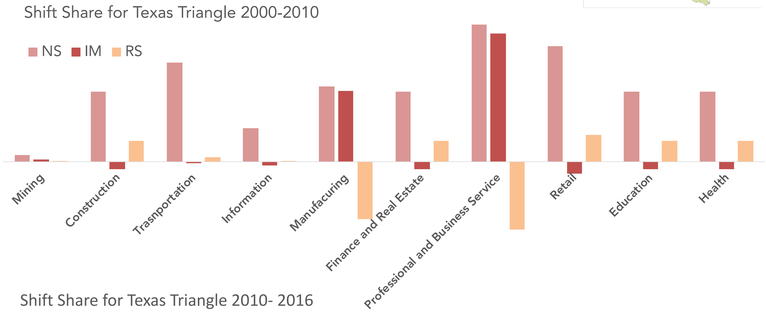


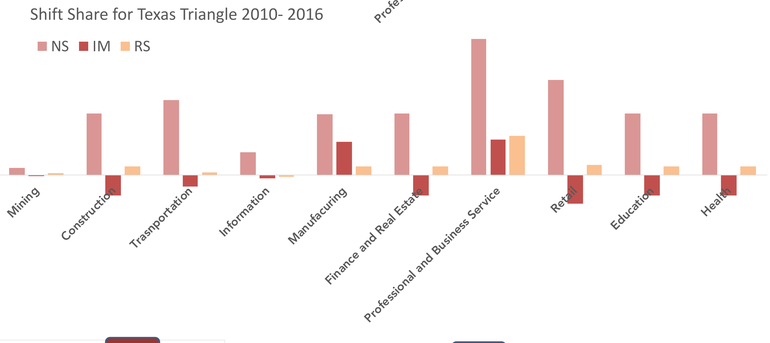


2. Economic Restructuring

We used Shift Share Analysis as a tool to understand what are the major powerhouse in the Triangle. This would help when we identify the travel demand later.

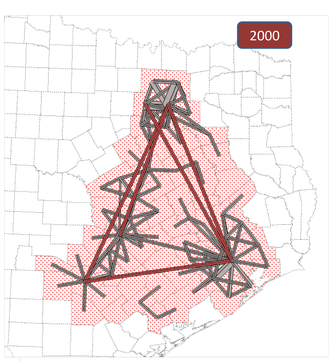
The leading industries in the Triangle are Retail, Education, Health and finance and real estate. Finance, real estate and construction were struck during the repression, but they now have reinstate their strength. It is likely to see bigger economic growth accompanying with greater regional traffic demand in the future

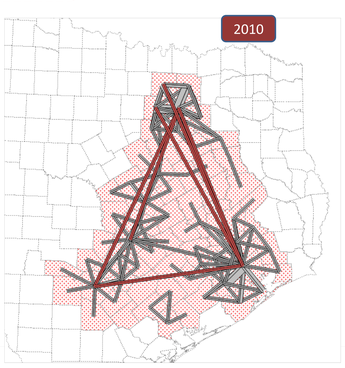


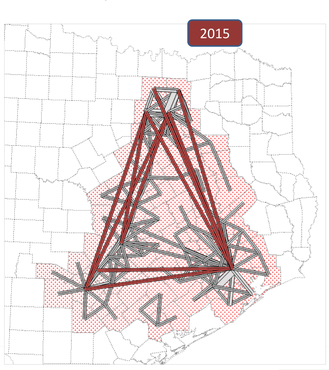


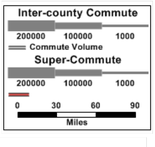
3.Commute Patterns

Inter-county commute has been consistently growing over the years. Super-commuting (lines in red) has increase as we can see more lines appearing from among four-city areas. Commute trips as part of long-distance business trip is vital in understanding regional travel demand and cross-tabulation with trip frequency and trip generation.









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PI(s): Ming Zhang
GRA(s): Ziqi Liu

Understanding Megaregion as a Global Urbanization Process

Implication for strategic transportation infrastructure investment

INTRODUCTION

1. BACKGROUND

With the development of economy and technology, regional connectivity reinforced and urban agglomeration became a global phenomenon in the past decades. Megaregion is defined as a cluster of cities with more than one metropolitan and the hinterland joined together with frequent economic and information connectivity. To meet the criteria of megaregion, not only the area and population standard are required, but also the capital accumulation and technology concentration, which brings different definition of the megaregion.

Besides definition on this phenomenon, scholars in urban and regional planning are interested in the institutional implication to facilitate this regional development. Cities have gone through the growing process from municipal city, metropolitan, megacity and city region, with the expansion of its territory. In each level, there is corresponded governance and administrative entity to coordinate the transportation, land use and economic development. It is reasonable to speculate that the new phenomenon of megaregion will stimulate a structural change on regional cooperation.

2.RESEARCH QUESTIONS

Based on these concerns, my research question would be: what is the motivation of megaregions and what is the planning implication based on this phenomenon.

To study this topic from a global perspective, it is instrumental to trace back to the origin of megaregion and how it is found and developed in different countries. In particular, I would like to see the differences among megaregions in different countries, China, US and Europe and the planning related policies regarding regional collaboration.

3.RESEARCH AGENDA

Academic year	Tasks and deliverables
1	• Data collection • Literature review
2	• Research questions identification
3	• Methodology search
4	• Research proposal
5+	• dissertation

ORIGINS AND DEFINITION OF GLOBAL MEGAREGIONS

From megalopolis to megaregions – US

- Megalopolis (Jean Gottman, 1961)
  the Northeastern United States stretching from New Hampshire to Virginia.
- Megaregions (Regional Planning Association)
  (11) Cascadia, Northern California, Southern California Arizona, Sun Corridor, Front Range, Texas Triangle, Gulf Coast, Midwest, Piedmont Atlantic, Florida, Northeast
- Megaregions (USDOT FHWA)
  (13) Pacific Northwest, N. California, S. California, Arizona, Front Range, Central Plain, Texas Triangle, Midwest, Mid-South, Piedmont, Northeast, Mid-Atlantic, Florida

From City-Region to Mega-City Region – Europe

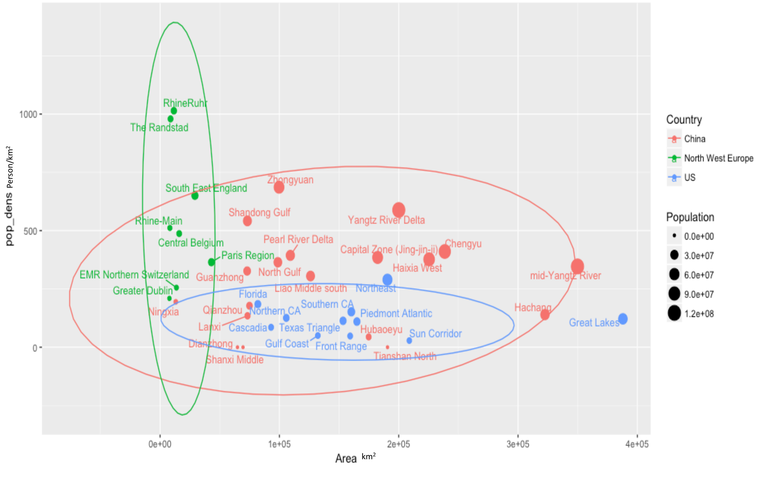
- City-region
  "a strategic and political level of administration and policy making, extending beyond the administrative boundaries of single urban local government authorities to include urban and/or semi-urban hinterlands." (Tewdwr-Jones and McNeill, 2000)
  Governance level
- Mega-city region
  "a series of anything between 10 and 50 cities and towns, physically or more larger central cities, and drawing enormous economic strength from a new functional division of labor" (Peter Hall and Kathy Pain, 2006)
  An extension of mega-city
  POLYNET
  Regional network connectivity (commuting and information flow)

From Urban Economic Zone to Megaregion- China

- Urban economic zone
  Three developing axis and nine urban economic zone (Gu, 1991)
- Megaregions
  "3+11+14" based on different scales (Fang, 2005)
  "15+8"based on development degree (Fang, 2013)
- National Corpus Function Area Plan
  Territory classification based on developing priority: prior development zone, key development zone, restricted development zone and forbidden development zone
  Considered as the base for megaregion
- National New Urbanization Plan (2014-2020)
  "5+9+6" national level, regional level and local level
  For high-efficient land use and resource integration

Megaregion	Area km²	Population (million)	Density (person/km2)	Megaregion	Area km²	Population (million)	Density (person/km2)
US Megaregions				**China City-Cluster Region**			
Cascadia	93,024.48	7.9	85.41	Yangtz River Delta	200,056.30	117.7	588.48
Florida	81,932.85	15.1	184.83	Capital Zone (Jing-jin-ji)	182,320.92	70.2	385.09
Front Range	159,297.37	7.7	48.15	Pearl River Delta	109,170.38	43.0	393.88
Great Lakes	387,885.09	47.2	121.64	mid-Yangtz River	349,829.34	121.2	346.48
Gulf Coast	132,218.20	6.6	50.17	Chengyu	238,600.54	98.0	410.6
Northeast	190,550.71	55.2	289.67	Hachang	322,559.10	45.2	140.07
Northern CA	105,763.97	13.3	125.68	Haixia West	225,471.90	85.0	376.81
Piedmont Atlantic	164,974.60	18.2	110.02	Zhongyuan	99,690.64	68.4	686.22
Southern CA	160,265.88	24.4	152.01	Guanzhong	72,958.39	23.9	326.9
Sun Corridor	208,881.04	6.0	28.51	Liao Middle south	126,078.30	38.5	305.37
Texas Triangle	153,357.97	17.4	113.31	Tianshan North	190,612.36	0.0	0
Europe Mega-City Region				North Gulf	98,705.23	36.0	364.42
South East England	29,184.00	19.0	650.5	Shandong Gulf	73,192.69	39.7	541.86
The Randstad	8,757.00	8.6	979.3	Hanzhong Plain			
Central Belgium	16,000.00	7.8	487.5	Ningxia	13,156.34	2.6	194.58
RhineRuhr	11,536.00	11.7	1014.22	Lanxi	73,269.15	9.9	134.85
Rhine-Main	8,211.00	4.2	511.51	Qianzhou	74,924.69	13.3	177.91
EMR Northern Switzerland	13,700.00	3.5	255.47	Shanxi Middle	69,509.68		0
Paris Region	43,019.00	15.7	364.76	Hubaoeyu	174,806.45	7.7	44.28
Greater Dublin	7,814.00	1.6	209.53	Dianzhong	64,852.52	0.0	0

Megaregion Comparison across Three Regions in Area, Population and Density



MOTIVATION AND CONCLUSION

US Megaregion	• Grew in numbers, from a specific phenomenon (the Northeast) to a national wide definition; • Attracted attentions in academia for decades; • Has no unified official definition;
Europe Mega-City Region	• Grew in scales, from monocentric city-region to polycentric MCR including surrounding middle and small-scale cities, • Focused on interior connection within individual MCR
China City Cluster Region	• Raised up from upstream and was planned nationwide; • Has a hierarchy based on the developmental level; • Functioned as spatial carrier of New-Urbanization Plan and focused on the land use transaction;

- Megaregion is a global phenomenon detected in Europe, North American and east Asia.
- The scale of megaregions varies based on different definition and statistic units. European MCRs have the most compact territory while China and US have the similar scale. Urban agglomerations in China are more heterogeneous in scale and the unevenness is due to the imbalanced regional development.
- In China, megaregion is a top-down movement led by the National Development and Reform Commission for the past decade and under this national strategy, transportation infrastructure construction, especially High-Speed Rail were highly supported. In US, after studied by academia for more than a decade, megaregion attracted USDOT's attention and the concept was put into their annual report in 2015 for the first time. But there is no concrete policy under megaregion so far.

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