Southwest Region University Transportation Center

Future Mobility Demand in Megaregions: A National Study with a Focus on the Gulf Coast

SWUTC/13/600451-00074-1

Center for Transportation Research
University of Texas at Austin
1616 Guadalupe St., 4th Floor
Austin, Texas 78701

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
SWUTC/13/600451-00074-1		

4. Title and Subtitle	5. Report Date
Future Mobility Demand in Megaregions: A National Study with a Focus on the Gulf Coast	September 2013
	6. Performing Organization Code
7. Author(s) Ming Zhang and Wenjia Zhang	8. Performing Organization Report No.
9. Performing Organization Name and Address Center for Transportation Research University of Texas at Austin 3208 Red River, Suite 200 Austin, TX 78705-2605	10. Work Unit No. (TRAIS)
	11. Contract or Grant No. DTRT12-G-UTC06
12. Sponsoring Agency Name and Address Southwest Region University Transportation Center Texas A&M Transportation Institute Texas A&M University System College Station, TX 77843-3135	13. Type of Report and Period Covered Final Report
	14. Sponsoring Agency Code

15. Supplementary Notes

Supported by a grant from the U.S. Department of Transportation, University Transportation Centers Program and general revenues from the State of Texas.

16. Abstract

About three fourth of national population and wealth are concentered in the 11 megaregional areas that occupy one fourth of the land areas in the US. NHTS reveal that megaregions also concentrate current and future mobility demand. This report presents an approach that utilizes aggregate data for mobility study (for both passenger and freight) in a megaregional scale through a case study of the Gulf Coast megaregion (GCM). GCM exhibits unique travel characteristics relative to the national trend. A preliminary analysis on freight flow was also conducted for the GCM areas utilizing the 2002 and 2007 Commodity Flow Survey (CFS) data. The study shows that the GCM area would experience an enormous amount of mobility growth by year 2050. The per capita traffic volume generated by each traveler in 2050 would double the 2010 level. The total traffic volume in 2050 would grow much faster, four times higher than in 2010. Freight demand in the GCM area is also fast growing. The projected trends of future travel demand indicate a growing pressure on the transportation infrastructure in GCM. It is unlikely that the demand for high-speed travel can all be met by air travel. Accordingly, planning for megaregional transportation should seriously consider high-speed travel in the form of High Speed Rail (HSR) to accommodate the future travel demand in the GCM area.

17. Key Word	18. Distribution Statement
Travel Demand, Megaregion, the Gulf Coast Megaregion (GCM), High-speed Travel	No restrictions. This document is available to the public through NTIS: National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	67	n/a

Form DOT F 1700.7 (8-72) **Reproduction of completed page authorized**

FUTURE MOBILITY DEMAND IN MEGAREGIONS:

A NATIONAL STUDY WITH A FOCUS ON THE GULF COAST

by

Ming Zhang
Associate Professor
Community and Regional Planning
University of Texas at Austin
Austin, TX 78712
Tel: 512-471-1922
Fax: 512-471-0716
Email: zhangm@mail.utexas.edu

Wenjia Zhang
Graduate Research Assistant
Community and Regional Planning
University of Texas at Austin
Austin, TX 78712
Email: wenjiazhang@utexas.edu

Sponsored by the
Southwest Region University Transportation Center

Research Report SWUTC/13/600451-00074-1

Center for Transportation Research
University of Texas at Austin
Austin, Texas 78712

September 2013

DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. This document is disseminated under the sponsorship of the Department of Transportation, University Transportation Centers Program in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof.

ACKNOWLEDGEMENTS

The authors recognize that support for this research was provided by a grant from the U.S. department of Transportation, University Transportation Centers program to the Southwest Region University Transportation Center, which is funded, in part, with general revenue funds from the State of Texas.

ABSTRACT

About three fourth of national population and wealth are concentered in the 11 megaregional areas that occupy one fourth of the land areas in the US. NHTS reveal that megaregions also concentrate current and future mobility demand. This report presents an approach that utilizes aggregate data for mobility study (for both passenger and freight) in a megaregional scale through a case study of the Gulf Coast megaregion (GCM). GCM exhibits unique travel characteristics relative to the national trend. A preliminary analysis on freight flow was also conducted for the GCM areas utilizing the 2002 and 2007 Commodity Flow Survey (CFS) data. The study shows that the GCM area would experience an enormous amount of mobility growth by year 2050. The per capita traffic volume generated by each traveler in 2050 would double the 2010 level. The total traffic volume in 2050 would grow much faster, four times higher than in 2010. Freight demand in the GCM area is also fast growing. The projected trends of future travel demand indicate a growing pressure on the transportation infrastructure in GCM. It is unlikely that the demand for high-speed travel can all be met by air travel. Accordingly, planning for megaregional transportation should seriously consider high-speed travel in the form of High Speed Rail (HSR) to accommodate the future travel demand in the GCM area.

EXECUTIVE SUMMARY

Megaregions are playing an increasingly important role in regional and global economic competition. About three fourth of national population and wealth are concentered in the 11 megaregional areas that occupy one fourth of the land areas in the US. NHTS reveal that megaregions also concentrate current and future mobility demand. Megaregions' major MSAs contributed to 32% of total personal miles traveled in the US in 2001. The figure grew up to 45% in 2009. This report presents an approach that utilizes aggregate data for mobility study (for both passenger and freight) in a megaregional scale through a case study of the Gulf Coast megaregion (GCM). GCM exhibits a contrary trend to the nation in travel. While traffic condition measured by average travel speed in most megaregions showed improvements from 2001 to 2009, it became worse off in GCM. Driving share increased in the US; yet in GCM, driving decreased and walking and bicycling increased. A preliminary analysis on freight flow was also conducted for the GCM areas utilizing the 2002 and 2007 Commodity Flow Survey (CFS) data. Freight demand in the GCM area is fast growing. It is especially the case that shipment by airplanes has a very limited share and rail keeps its significant role from and to GCM.

The study shows that the GCM area would experience an enormous amount of mobility growth by year 2050. The per capita traffic volume generated by each traveler in 2050 would double the 2010 level. The total traffic volume in 2050 would grow much faster, four times higher than in 2010. The projection of mode split in the GCM area reveals a general trend that the share of high-speed travel (HST) would increase significantly while those of all other conventional low-speed modes, including rail, bus, and car, would decrease to some degree.

The projected trends of future travel demand indicate a growing pressure on the transportation infrastructure in the GCM area. It is unlikely that the demand for high-speed travel can all be met by air travel. Accordingly, planning for megaregional transportation should seriously consider high-speed travel in the form of High Speed Rail (HSR) to accommodate the future travel demand in the GCM area. If such a HSR would be built along the gulf coast, the study suggests five potential stations in five counties, including Hidalgo, Nueces, Harris, Livingston, and Rosa from west to east.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. Introduction

Megaregion denotes the connected networks of multiple metropolitan areas. National projections show that, by 2050, the US population will grow by 40% from its Year 2000 level; about three quarters of the nation's population and wealth will concentrate in the eleven emerging megaregions in continental US ((RPA, 2006). Two of them are located in the Southwest Region: the Texas Triangle and the Gulf Coast (Figure 1). One feature distinguishing this region's megaregions from the rest in the nation is that the Texas Triangle and the Gulf Coast conjunct in the Houston-Galveston metropolitan area, as defined by American 2050 (RPA, 2006).

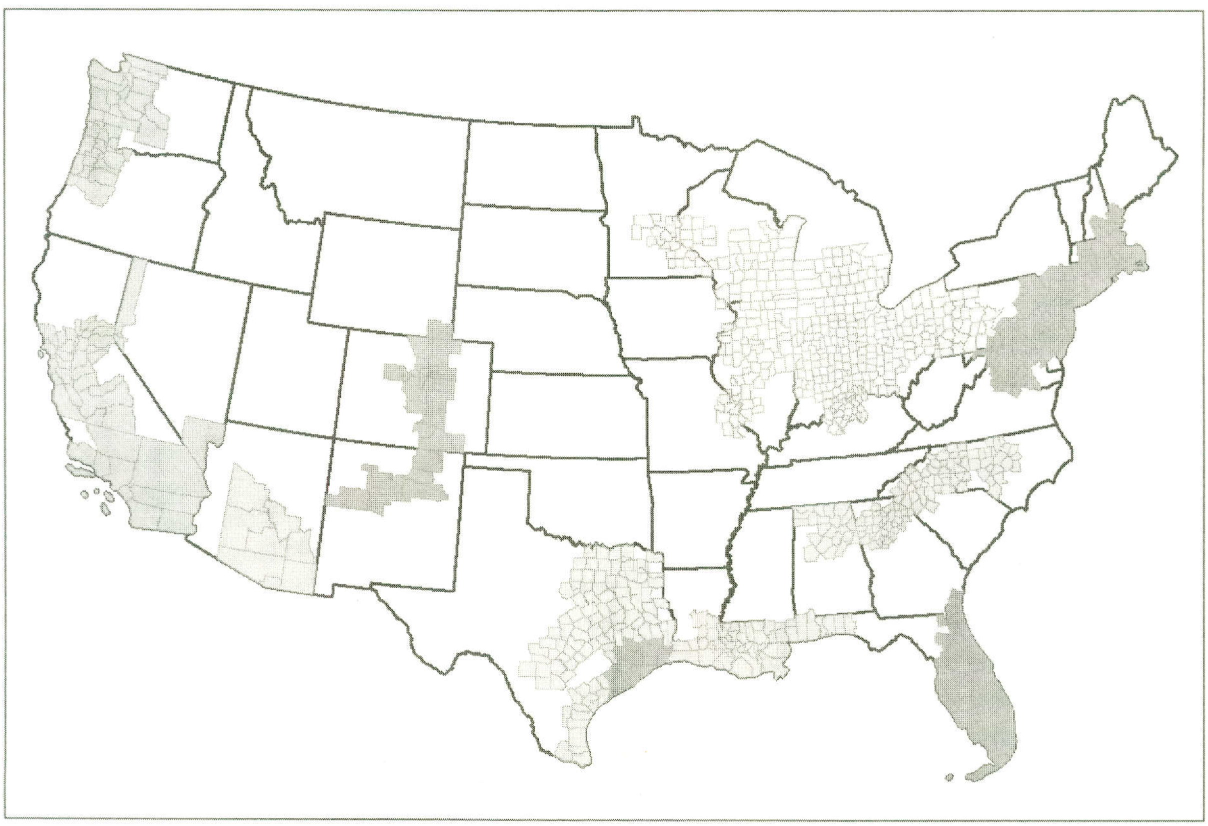


Figure 1.1 Megaregions in the US (based on RPA, 2006)

Megaregions as new economic geographies are playing a critical role in national / regional economic growth and in global competition (RPA, 2006; Florida et al., 2008). There also centralize a large and increasing portion of intra- and inter-city passenger and freight travel in the USA. The 2009 National Household Travel Survey (NHTS) show that person miles traveled (PMT) generated in the megaregion areas accounted for more than 45% of the national total PMT in the US. It showed an increase by 32% from 2001 (NHTS, 2001; 2009)

Countries in Asia and Europe have been investing in megaregions to strengthen their international competitiveness while the US interest in megaregional development only started after 2004 (Carbonell and Yaro, 2005). Nationwide a networked research effort has been ongoing, with researchers conducting case study of the megeragions where their home institutions locate; The UT Austin faculty was part of the network. The first phase (approximately five years in 2005-10) of megaregion study in the US focused mainly on completing baseline reports for individual megaregions (for further information, see http://www.america2050.org/). Since 2011, megaregion research has extended to investigate sectorial issues such as transportation, governance, environmental protection, and social equity. This study focuses on mobility issues. It first examines mobility trends in megaregions nationally. It then conducts in-depth analysis on future mobility demand in the Gulf Coast megaregion. The study extends from prior work on the Texas Triangle (Zhang and Chen, 2009).

The study presents a practical significance. Metropolitan areas within the megaregions have already faced such problems as roadway congestion, emissions, and development disparity, which are threatening regional prosperity and the Quality of Life. These problems will only be compounded by future population and economic growth. Many of the problems traverse metropolitan boundaries and even cross multiple states as in the Gulf Coast case. The problems are unlikely to be solved within individual jurisdictions. This is because metropolitan planning organizations (MPO) are largely constrained to their jurisdictional areas. While individual MPOs provide rather detailed pictures of travel in their jurisdictions, forces of growth from the interactions among metropolitan areas and between the metro areas and their hinterlands are not accounted for. Mobility demand in the megaregion cannot be well understood by simply summing up the numbers from individual metropolitan areas. A megaregion approach helps overcome the limits that MPOs face.

The study completed the following tasks:

1) *Examine travel characteristics and trends in the eleven magaregoins of the US*: The study first benchmarked passenger travel characteristics, including shares of various travel modes (e.g., airplanes, private cars, bus and rail transit, and walk/bike et al) and average and total trip length (in both distance and time). Next, the study examined trends of these characteristics with use of multi-decade national travel surveys. Data used for the research mainly comes from National Household Travel Surveys (NHTS) from 2001-2009.

2) *Project future travel demand in the Gulf Coast megaregion*: Based on the study of national trend and projected growth in population, employment, and income, the study projected mobility demand measured by PMT for year 2050 in the Gulf Coast. The study adapts the aggregate projection method developed in the study of the Texas Triangle (Zhang and Chen, 2009).

3) *Identify mobility challenges and explore supply strategies to meet the future demand for mobility*: Megaregions typically cover large geographies that require high-speed travel means to overcome spatial separation. Many Asian and European countries have been developing high-speed rail (HSR) to serve their megaregions. The study looked at strategies of high-speed travel, including air and HSR. Given recent setback in HSR development in a number of States, exploring options for high-speed travel is particularly important to US megaregional transportation studies.

4) *Draw policy implications and propose planning strategies*: Finally, the research offered recommendations for planning and policy-making for megaregional transportation development, with specific attentions to the Gulf Coast in conjunction with the Texas Triangle Megaregion.

Following these research questions, the rest of this report is organized as follows: Section 2 provides geographical distribution of the US megaregions and describes travel characteristics and trends among them; Section 3 projects the future travel demand in the Gulf Coast megaregion through two types of methods; Section 4 draws policy implications and conclusion. Appendix provides freight data collected for the 11 megaregions in the USA.

2. Travel Characteristics and Trends in the US Magaregoins

The first step to study travel characteristics in the US megaregions is to clarify a working definition of megaregion for this study, given that there exist a variety of competing frameworks identifying a megaregion. For instance, scholars from the School of Design the University of Pennsylvania (2004) recognizes a "megaregion" as "extended networks of metropolitan centers linked by interstate highway and rail corridors." This definition focuses on the network connection between major metropolitan regions. Virginia Tech's Metropolitan Institutes (MI) delineates ten megaregional areas in the US based on such factors as population size, geographical contiguity, cultural and historical ties, links of large centers, and goods and service flows (Lang and Dhavale, 2005). Regional Plan Association (RPA) identified ten megaregions initially in 2006 and later adjusted to eleven as shown in Figure 1. They emphasize eco-environmental systems, infrastructure, economic, and land use patterns. The Gulf Coast megaregion (GCM) is regarded as one of the most important megaregions in both MI's and RPA's delineations, although they differ slightly in drawing GCM's geographical boundaries. This study follows the most recent definition by RPA (Figure 1).

The eleven megaregions delineated by RPA (2009) include the Northeast, the Great Lakes, North California, Southern California, Cascadia, Piedmont Atlantic, Arizona Sun Corridor, the Front Range, Southern Florida, the Texas Triangle, and the Gulf Coast (Figure 1). Table 2.1 shows the numbers of counties forming each megaregion, and the population growth trends in these areas. Among them, the Great Lakes megaregion is the largest in terms of number of counties (388) and space. GCM consists of 75 counties with an area of about 60 thousand square miles, ranking No. 6th. From 2000 to 2010, population has grown in all of the eleven megaregions, ranging from 3% to 25%. GCM population grew by 14%. Table 2.1 also reports projected populations in the megaregions by 2025. GCM is expected to see a population growth by 35% from 2000 to 2025.

Table 2. 1 Description of the US Megaregions

Megaregion	No. of Counties 2010	Area in sq mi	Population 2000	Population 2010	% from 2000 to 2010	Estimated % from 2000 to 2025
Southern California	10	61,986	21,858,662	24,361,642	11	31
Southern Florida	42	38,356	14,686,285	17,272,595	18	45
North California	31	47,928	12,724,861	14,037,605	10	36
Northeast	142	61,942	49,563,296	52,332,123	6	17
Piedmont Atlantic	121	59,525	14,855,052	17,611,162	19	38
Arizona Sun Corridor	8	48,803	4,535,049	5,653,766	25	62
Cascadia	34	47,226	7,400,532	8,367,519	13	38
Front Range	31	56,810	4,733,679	5,544,202	17	44
Gulf Coast	75	59,519	11,747,587	13,414,934	14	35
Texas Triangle	101	85,312	16,131,347	19,728,244	22	46
Great Lakes	388	205,452	53,768,125	55,525,296	3	17

Notes: 2010 data is from 2010 census; and all other data are from RPA (2009)'s report: Defining U.S. Megaregions, by the link http://www.america2050.org/upload/2010/09/2050_Defining_US_Megaregions.pdf

To understand travel characteristics and trends in the megaregions, we utilize NHTS data that are available in the public domain. NHTS datasets provide information on travel characteristics spatially at the MSA/PMSA level. Table 2.2 presnts base population information in the consisting MSA/PMSA in GCM. Table 2.3 reports travel characteristics, including total PMT, PMT per capita, travel time per capita, and mode split of the 11 megas. In addition, for reference, we group the MSA/PMSA into four types of regions based on their locations and population size. They are: MSAs with population more than one million and within the megaregions, MSA areas with population more than one million but not in the megaregions, MSA areas with population lower than 1 million, and non-MSA areas.

In 2001, more than 32% of total PMTs are generated in the MSAs with population more than 1 million inside megaregions. The corresponding percentage increased to 45% in 2009. This change suggests a trend of concentrated mobility growth in the megaregions that covers 26% of total land areas in the country. Figures from individual megas show that the rising growth shares occurred mostly in southern megaregions, namely, Gulf Coast, Texas Triangle, Southern Florida, Arizona Sun Corridor, and Southern California. Two northern exceptions are Piedmont and northern California. In GCM, a similar trend is observed. In 2001, GCM accounts for 1.05% of total PMT. In 2009, the figure increased to 2.94%, a net rise of about two percentage points.

2.1 Geography of GCM

This section focuses on the geographical delineation and characteristics of the GCM area. GCM contains coastal counties from five states located by the Gulf of Mexico; they are Texas, Louisiana, Mississippi, Alabama, and Florida. The economy of the Gulf Coast region is dominated by industries related to fishing, aerospace, agriculture, and tourism. Major incorporated cities in the region include Brownsville, Corpus Christi, Houston, Baton Rouge, New Orleans, Biloxi, Mobile, Pensacola, Tampa, and Sarasota. They operate ports in various sizes and are the economic cores of their respective metropolitan areas.

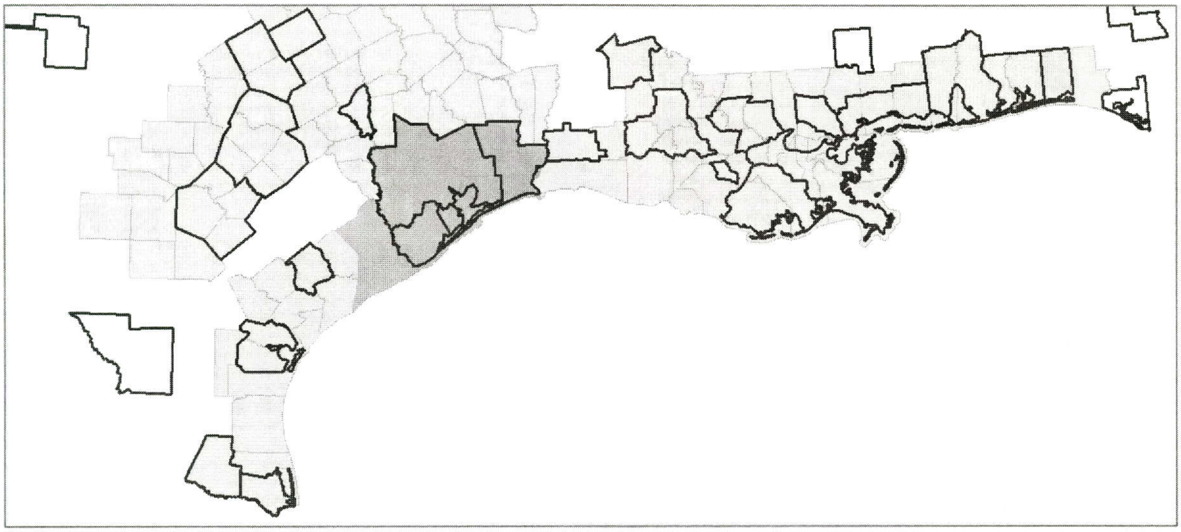


Figure 2. 1 Location of MSAs in the Gulf Coast Megaregion (in blue and purple areas)

Fifteen MSAs are located in GCM (Figure 2.1 & Table 2.2), including Houston-Sugar Land-Baytown, Tampa-St. Petersburg-Clearwater, New Orleans-Metairie-Kenner, Baton Rouge-Pierre Part, McAllen-Edinburg-Mission, North Port-Bradenton-Sarasota, Cape Coral-Fort Myers, Pensacola-Ferry Pass-Brent, Corpus Christi, Mobile, Brownsville–Harlingen, Beaumont-Port Arthur, Naples-Marco Island, Gulfport-Biloxi, and Houma-Bayou Cane-Thibodaux. These MSAs account for more than 90% of GCM population. Table 2.2 shows population changes from 2000 to 2009 in the fifteen MSAs. All but three MSAs saw significant population growth in the decade. In percentage terms, the Cape Coral-Fort Myers area in Florida experienced the fastest population growth (33%). The most populated MSA is the Houston-Sugar Land-Baytown area in Texas, which also saw a double-digit growth. Accompanying the growth in population in the MSAs was fast mobility growth in the GCM area.

Table 2. 2 Metropolitan Statistical Areas on the Gulf Coast Megaregion

Rank	Metropolitan Statistical Area	2009 Pop	2000 Pop	Δ Pop	Combined Statistical Area
1	Houston-Sugar Land-Baytown, TX MSA	5,867,489	4,715,407	+24.43%	Houston-Baytown-Huntsville, TX CSA
2	Tampa-St. Petersburg-Clearwater, FL MSA	2,747,272	2,395,997	+14.66%	~primary census statistical area
3	New Orleans-Metairie-Kenner, LA MSA	1,189,981	1,316,510	-9.61%	New Orleans-Metairie-Bogalusa, LA CSA
4	Baton Rouge-Pierre Part, LA CSA	809,821	729,361	+11.03%	Baton Rouge-Pierre Part, LA CSA
5	McAllen-Edinburg-Mission, TX MSA	741,152	569,463	+30.15%	primary census statistical area
6	North Port-Bradenton-Sarasota, FL MSA	688,126	589,959	+16.64%	Sarasota-Bradenton-Punta Gorda, FL CSA
7	Cape Coral-Fort Myers, FL MSA	586,908	440,888	+33.12%	~primary census statistical area
8	Pensacola-Ferry Pass-Brent, FL MSA	455,102	412,153	+10.42%	~primary census statistical area
9	Corpus Christi, TX MSA	416,095	403,280	+3.18%	Corpus Christi-Kingsville, TX CSA
10	Mobile, AL MSA	411,721	399,843	+2.97%	Mobile-Daphne-Fairhope, AL CSA
11	Brownsville–Harlingen, TX MSA	396,371	335,227	+18.24%	~Brownsville-Harlingen-Raymondville, TX CSA
12	Beaumont-Port Arthur, TX MSA	378,477	385,090	-1.72%	~primary census statistical area
13	Naples-Marco Island, FL MSA	318,537	251,377	+26.72%	~primary census statistical area
14	Gulfport-Biloxi, MS MSA	238,772	246,190	-3.01%	Gulfport-Biloxi-Pascagoula, MS CSA
15	Houma-Bayou Cane-Thibodaux, LA MSA	202,973	194,477	+4.37%	~primary census statistical area

Source: NHTS, 2009 and Census, 2010

2.2 Travel Trends from NHTS

Tables 2.3 and 2.4 report mobility conditions in megaregion MSAs with two indicators, PMT per capita and travel time per capita. The MSA averages suggest that travelers in large MSAs of megaregions tend to travel slower than in large MSAs of non-megaregions. For instance, in 2001, the average PMT in the MSAs within megaregions was about 42 miles, and the average travel time was 92.36 minutes (Table 2.3). This gives an average travel speed of 27.23 miles per hour, slightly lower than the large MSAs not in megaregions (42.29 miles/82.87 minutes=30.62 miles per hour). In 2009, travel conditions improved. Average travel speed increased to 28.52 miles per hour and the average travel time in the megaregion's MSAs decreases from 92.36 to 87.43 minutes per capita (Table 2.4). Yet the overall picture remains the same: mobility as measured by average travel speed is lower in megaregions than in other regions. Look into GCM, PMT appeared decreased from 46.14 in 2001 to 44.11 in 2009. Yet average travel time increased from 87.48 minutes to 90.22 minutes during the same time period. The average travel speed in the MSAs in the GCM areas thus drops from 31.65 to 29.33 miles per hour.

The residents living in the MSAs inside megaregions tend to drive less and take public transit, walk, and bike more. Among these megaregional areas, about 83% of trips were made by vehicles, including car, van, SUV, truck, and other types of motor vehicle in 2001; about 5% of trips used public transit, including local bus, city to city bus, inter-city train, commuter train, street car, and subway; and above 11% of trips were completed by walking or bicycling. In 2009, the share of vehicle use raised to above 85%, and the share of public transit use fell to only 2.7%. Contrary to the national trend, the share of vehicle use in GCM dropped from 90.93% in 2001 to 87.31% in 2009. The share of walking or bicycling grew from 6.08% to 9.37%. The share of public transit stayed unchanged at 2.3%, suggesting that the 3 percentage points of dropping in vehicle use translated to the rise of share by non-motorized modes.

In summary, data from the first decade of the century show that megaregions absorb more population growth and generate more travel demand than the rest of the country. More than 74% of the national population concentrates in the 11 megaregions, while they occupy less than 26% of the nation's land areas. About 45% of total PMT is generated in the megaregions' major

MSAs. The megaregional areas appear to be associated with longer average travel time and lower travel speed, probably due to more serious traffic congestion than other regions. People living in the megaregions drive less and travel more by public transit, walking, and bicycling than other regions. The tendency of mode split in the megaregions is similar to other regions in the US: increasing share of vehicle use and decreasing share of public transit use. Overall, mobility conditions in megaregions improved from 2001 to 2009. Nevertheless, GCM exhibits a number of travel characteristics and trends different from those of the whole megaregions areas. For example, traffic condition became worse in the GCM area from 2001 to 2009. There appeared decreasing share of driving and increasing of walking or bicycling in GCM. The specific travel attributes of the GCM area warrant further studies.

Table 2. 3 Travel Characteristics in MSAs inside and outside megaregions (in 2001)

Regions	Total PMT		PMT per capita, mile/cap	Travel Time per capita, min/cap	Mode Split (%)			
	(mile)	(% of total)			Vehicle	Public Transit	Non-motor	Other
Gulf Coast	63907	***1.05***	46.14	87.48	90.93	2.34	6.08	0.66
Texas Triangle	121163	***1.99***	50.70	91.03	91.85	1.61	5.94	0.60
Piedmont Atlantic	73590	***1.21***	46.25	91.55	90.88	2.59	5.99	0.53
Southern Florida	61684	***1.02***	39.19	90.50	88.66	2.11	8.56	0.66
Northeast	926868	***15.26***	39.23	94.78	77.08	7.41	14.36	1.16
Great Lake	384316	***6.33***	43.08	87.10	88.10	2.98	8.41	0.51
Front Range	26277	***0.43***	45.15	96.75	89.32	1.78	8.41	0.49
Arizona Sun Corridor	34846	***0.57***	53.78	92.55	85.07	1.95	10.97	2.01
Southern California	124944	***2.06***	43.52	95.44	85.89	2.29	11.08	0.75
North California	81103	***1.34***	50.25	91.87	84.31	2.97	12.05	0.67
Cascadia	52951	***0.87***	38.93	87.23	86.61	3.77	8.94	0.68
MSA upper 1m & in Megas	1951650	***32.13***	41.91	92.36	82.68	4.99	11.44	0.89
MSA upper 1m & not in Megas	325201	***5.35***	42.29	82.87	89.39	2.25	7.75	0.61
MSA under 1m pop	2463285	***40.56***	37.02	83.55	87.77	3.04	8.32	0.87
Non-MSA Areas	1333620	***21.96***	48.81	88.19	90.12	2.24	6.93	0.71

Data Source: NHTS (2001)

Table 2. 4 Travel Characteristics in MSAs inside and outside megaregions (in 2009)

Regions	PMT		PMT per capita, mi/cap	Travel Time per capita, min/cap	Mode Split			
	mile	% of total			Vehicle	Public Transit	Non-motor	Other
Gulf Coast	326887	***2.94***	44.11	90.22	87.31	2.33	9.37	0.99
Texas Triangle	800324	***7.20***	46.82	88.71	89.70	1.62	7.70	0.97
Piedmont Atlantic	598927	***5.39***	43.44	84.99	90.25	1.86	7.07	0.81
Southern Florida	518944	***4.67***	37.03	85.15	86.18	1.75	10.78	1.29
Northeast	789065	***7.10***	40.25	94.38	78.19	6.21	14.27	1.33
Great Lake	284205	***2.56***	41.36	85.52	87.08	3.00	9.13	0.80
Front Range	13260	***0.12***	46.36	84.53	86.32	1.93	11.52	0.22
Arizona Sun Corridor	328006	***2.95***	37.85	79.81	86.53	2.01	9.86	1.60
Southern California	926240	***8.34***	39.62	85.83	84.38	1.97	12.58	1.07
North California	409594	***3.69***	43.99	87.93	82.21	2.23	14.53	1.03
Cascadia	42936	***0.39***	53.01	87.70	79.73	3.42	15.21	1.65
MSA upper 1m & in Megas	5038389	***45.35***	41.56	87.43	85.32	2.67	10.89	1.11
MSA upper 1m & not in Megas	3233143	***29.10***	40.62	82.94	88.99	1.74	8.38	0.89
MSA under 1m pop	432164	***3.89***	39.59	81.82	88.31	2.30	8.41	0.98
Non-MSA Areas	2405431	***21.65***	46.98	87.19	89.44	1.77	7.72	1.07

Data Source: NHTS (2009)

2.3 Trends of Freight Flows from Commodity Freight Survey: A Focus on GCM Area

This section reports study of freight mobility using Commodity Freight Survey (CFS)[1]. CFS was conducted in 1993, 1997, 2002, 2007 and most recently in 2012. As of today the 2012 CFS data is not available. Among previous CFS only the 2002 and 2007 data provide enough freight information -- including types, origins and destinations, values, weights, modes of transport, distance shipped, and ton-miles of commodities shipped. The data are available at the metropolitan level only. CFS covers major metropolitans, and combines the adjacent metropolitans into CFS areas. In 2002, the minimum geographical unit of CFS open to the public is the CSA. In 2007, the minimum geographical unit changes to the CFS area. The CSAs in 2002 is basically equivalent to the CFS area in 2007. But the 2007 CFS adds a number of metropolitans. Since many megaregions cross over the boundaries of multiple states, only 2002 and 2007 CFS are used here to examine the trends of freight movements in major metropolitans of the eleven megaregions.

Freight characteristics in all CFS areas in megaregions are shown in the Appendix, including total outbound freight value in 2007 (Table A.1), outbound freight value by mode in 2007 (Table A.2), overall inbound freight value in 2007 (Table A.3), inbound freight value by mode in 2007 (Table A.4), overall outbound freight characteristics in 2002 (Table A.5), and overall inbound freight characteristics in 2002 (Table A.6). The following analyses focus on the GCM area.

Table 2.5 and Table 2.6 show the trend of inbound and outbound freight characteristics of each CFS areas in the gulf coast from 2002 to 2007. The freight characteristics include freight values, tons of shipment, and ton-miles of shipment. In 2002, only two regions in the GCM were surveyed, the Houston-Baytown-Huntsville Area and the New Orleans-Metairie-Bogalusa Area. In 2007, the corresponding regions were extended to seven, adding Baton Rouge-Pierre Part CFS Area, Beaumont-Port Arthur CFS Area, Corpus Christi-Kingsville CFS Area, Lake Charles-Jennings CFS Area, and Mobile-Daphne-Fairhope CFS Area. The compared results reveal that the outbound freights grow fast in value, tons, and ton-miles in both

[1] More detailed information can be found at http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/commodity_flow_survey/index.html

Houston-Baytown-Huntsville Area and New Orleans-Metairie-Bogalusa Area, whereas the inbound freights only grow in tons of shipment. If these two major metropolitans can represent the whole GCM area, it is a general trend that fast increasing tons of freights would be originated from and delivered to the GCM area.

Table 2. 5 Inbound freight characteristics of each destination CFS in GCM area

Destination CFS Areas	2002			2007		
	Value (mil.$)	Tons (thou.)	Ton-miles (mil.)	Value (mil.$)	Tons (thou.)	Ton-miles (mil.)
Baton Rouge-Pierre Part, CFS Area				36,895	225,874	24,012
Beaumont-Port Arthur, CFS Area				829,980	158,674	7,711
Corpus Christi-Kingsville, CFS Area				41,194	65,155	4,077
Houston-Baytown-Huntsville, CFS Area	199,034	462,689	87,003	137,000	985,040	146,605
Lake Charles-Jennings, CFS Area				35,143	64,461	3,309
Mobile-Daphne-Fairhope, CFS Area				172,435	44,353	11,510
New Orleans-Metairie-Bogalusa, CFS Area	65,860	302,747	131,878	100,928	376,588	125,025

Source: CFS, 2002 and 2007

Table 2. 6 Outbound freight characteristics by destination CFS in GCM areas

Origin CFS Areas	2002			2007		
	Value (mil.$)	Tons (thou.)	Ton-miles (mil.)	Value (mil.$)	Tons (thou.)	Ton-miles (mil.)
Baton Rouge-Pierre Part, CFS Area				77,631	327,128	69,570
Beaumont-Port Arthur, CFS Area				79,852	305,484	62,836
Corpus Christi-Kingsville, CFS Area				41,027	220,840	46,415
Houston-Baytown-Huntsville, CFS Area	196,694	461,798	76,355	410,343	1,324,940	219,145
Lake Charles-Jennings, CFS Area				22,432	116,669	14,239
Mobile-Daphne-Fairhope, CFS Area				15,246	44,560	12,552
New Orleans-Metairie-Bogalusa, CFS Area	58,169	250,023	39,839	98,546	541,168	72,074

Source: CFS, 2002 and 2007

Table 2.7 and Table 2.8 show the mode shares of inbound and outbound freight in seven CFS areas in GCM in 2007. Four transport modes are compared, including truck, rail, air, and other mode (such as water, pipeline, multiple modes, and all other possible modes). If only considering the three major modes: truck, rail, and air, we find that most of inbound and outbound freight largely depend on trucks. Only less than one percentage of freight is shipped by air. About 4% of freights are delivered to the seven CFS areas by rail on average; but more than 10% of freights originated from these areas are shipped by rail. Among the eleven megaregions, only the GCM area uses rail for freight shipment so frequently (see Table A.2 in the Appendix).

Table 2. 7 Inbound freight characteristics by mode in GCM area (2007)

Destinations (CFS Areas)	Truck (%)	Rail (%)	Air (%)	Others (%)
Baton Rouge-Pierre Part, CFS Area	29.74	3.47	0.01	66.78
Beaumont-Port Arthur, CFS Area	27.05	7.64	NA	NA
Corpus Christi-Kingsville, CFS Area	52.78	1.01	0.03	46.18
Houston-Baytown-Huntsville, CFS Area	45.44	6.67	0.23	47.67
Lake Charles-Jennings, CFS Area	39.66	7.05	NA	NA
Mobile-Daphne-Fairhope, CFS Area	66.44	5.90	0.01	27.65
New Orleans-Metairie-Bogalusa, CFS Area	32.96	1.53	0.07	65.44

Note: NA indicates missing data.

Table 2. 8 Outbound freight characteristics by mode in GCM area (2007)

Origins (CFS Areas)	Truck (%)	Rail (%)	Air (%)	Others (%)
Baton Rouge-Pierre Part, CFS Area	33.67	17.15	NA	NA
Beaumont-Port Arthur, CFS Area	25.56	16.24	0.02	58.18
Corpus Christi-Kingsville, CFS Area	18.68	2.38	NA	NA
Houston-Baytown-Huntsville, CFS Area	48.30	11.88	NA	NA
Lake Charles-Jennings, CFS Area	29.41	19.91	NA	NA
Mobile-Daphne-Fairhope, CFS Area	66.13	16.59	0.24	17.03
New Orleans-Metairie-Bogalusa, CFS Area	21.74	7.53	0.28	70.45

Note: NA indicates missing data.

Table 2.9 presents the O-D pair of freight flows between seven CFS areas in the GCM area in 2007. Though some missing data exists, the results can still reveal the freight connection among these metropolitans. Table 2.10 and Table 2.11 may contain more information about the freight from inside and outside megaregions. For example, up to 70%-90% of freights originated from seven CFS areas in GCM are delivered to the eleven megaregions, while about 30%-40% of freight shipped to these areas are originated from those megaregional areas.

Table 2. 9 O-D pair of freight flows between different CFS areas in GCM area (2007)

	Destination CFS Areas (million ton-miles)						
Origin CFS Areas	Baton	Beaumont	Corpus	Houston	Lake Charles	Mobile	New Orleans
Baton Rouge-Pierre Part, CFS Area	633	129	2	NA	NA	43	1260
Beaumont-Port Arthur, CFS Area	102	956	NA	1497	78	70	NA
Corpus Christi-Kingsville, CFS Area	NA	NA	433	2947	NA	NA	NA
Houston-Baytown-Huntsville, CFS Area	760	NA	254	8082	193	357	NA
Lake Charles-Jennings, CFS Area	NA	50	NA	1232	260	53	9
Mobile-Daphne-Fairhope, CFS Area	36	NA	NA	97	0	80	249
New Orleans-Metairie-Bogalusa, CFS Area	1500	737	NA	3727	459	0	1353

Note: NA indicates missing data.

Table 2. 10 Destinations of freight originated from seven origin CFS areas in the GCM area

Origins (CFS Areas)	Destinations				
	Freight Values to the same CFS area (million $)	Freight Values to other CFS areas inside the same Mega (million $)	Freight Values to other CFS areas in other Megas (million $)	Freight Values to overall US regions(million $)	Percent of freight values delivering to CFS areas inside 11 Megas (%)
Baton Rouge-Pierre Part, CFS Area	30329	16071	7282	77631	69.15
Beaumont-Port Arthur, CFS Area	38469	14577	6870	79852	75.03
Corpus Christi-Kingsville, CFS Area	10755	8585	11350	41027	74.80
Houston-Baytown-Huntsville, CFS Area	246820	10879	58300	410343	77.01
Lake Charles-Jennings, CFS Area	13681	4131	1137	22432	84.47
Mobile-Daphne-Fairhope, CFS Area	3096	417	2151	15246	37.15
New Orleans-Metairie-Bogalusa, CFS Area	36760	26135	7011	98546	70.94

Table 2. 11 Origins of freight delivered to seven origin CFS areas in the GCM area

Destinations (CFS Areas)	Origins				
	Freight Values from the same CFS area (million $)	Freight Values from other CFS areas inside the same Mega (million $)	Freight Values from other CFS areas in other Megas (million $)	Freight Values from overall US regions(million $)	Percent of freight values from CFS areas inside 11 Megas (%)
Baton Rouge-Pierre Part, CFS Area	30329	25028	3551	137000	43.00
Beaumont-Port Arthur, CFS Area	38469	2536	1634	100928	42.25
Corpus Christi-Kingsville, CFS Area	10755	1393	2565	36895	39.88
Houston-Baytown-Huntsville, CFS Area	246820	33722	66067	829980	41.76
Lake Charles-Jennings, CFS Area	13681	4055	237	41194	43.63
Mobile-Daphne-Fairhope, CFS Area	3096	685	4431	35143	23.37
New Orleans-Metairie-Bogalusa, CFS Area	36760	13376	10229	172435	35.01

3. Future Travel Demand in the Gulf Coast Megaregion

3.1 Methodology

Zhang and Chen (2009) have developed aggregated models to project future travel demand in Texas Triangle megaregion. Their models were built on the work by Schafer and Victor's (2000) and Zahavi and Yacov's (1980) research of travel time and travel money expenditure. These projection techniques all rely on the assumption of fixed travel time budget (TTB) and fixed travel money budget (TMB). First, the fixed TTB assumes that humans prefer spending a fixed amount of time on their daily travel, including both motorized mobility and non-motorized mobility. By investigating the time-use and travel surveys from different cities and countries throughout the world, Schafer and Victor (2000) suggested that the motorized TTB is approximately 1.1 hours per person per day when motorized level is high enough. This TTB by motorized modes is closed to the average travel time per capita observed by the analysis of NHTS data in Section 2. From 2001 to 2009, the average travel time per capita in the megaregions decreases from 1.27 to 1.24 hour. Second, the fixed TMB assumption postulates that individuals devote a fixed proportion of income to traveling. Schafer (1998) collected data from twelve OECDs and three low-income countries, and found that TMB increases from about 5% at a motorization rate of almost zero passenger cars per 1000 capita to 10-15% at about 200 cars per 1000 capita, and remains approximately constant at higher ownership rates. In the United States, car ownership in 2005 was 776 cars per 1000 capita (UNECE, 2005).

Three steps are required to project total mobility demand (measured by per capita travel volume, or PMT) (see more detailed in Zhang and Chen, 2009), and travel demand by different modes, following Schafer and Victor's projection equations and parameters.

First, the number of population (POP) and the value of gross domestic product (GDP) should be projected based on historical data of the GCM area. The population projection is sourced from the Texas State Data Center (TxSDC), in which population is projected at county level until 2050 (TxSDC, 2012). The projection applies a cohort-component technique and provides four scenarios which assume the same set of mortality and fertility rates but different net migration rates. The net migration assumptions were derived from 2000-2010 patterns which have been altered relative to expected future population trends (during 2000-2010, Texas experienced the most rapid growth overall). Scenario 0 assumes zero net migration and population growth is only through natural increase; Scenario 0.5 assumes half of the net migration of those in the 2000s; and Scenario 1 assumes the net migration rates of the 2000s will characterize those occurring in the future.

Meanwhile, the GDP projection in the GCM area is estimated based on the GDP projection in the entire Texas State by the Texas Comptroller of Public Account (TCPA). Since the TCPA only project the future GDP of Texas from 2010 to 2035, Zhang and Chen (2009) have extended the projection to 2050 using a best curve fitting method. After achieving the Texas GDP from 2010 to 2050, we can calculate the GCM GDP if knowing the percentage GDP share of the GCM in Texas. In this report, this percentage share is approximately computed by the percentage share of the GCM income relative to the state as a whole, with data from Bureau of Economic Analysis (BEA, 2012).

Second, the projections of population and GDP are employed to calculate the projected per capita travel volume (TV). According to Schafer and Victor (2000), there is a strong relationship between income and the total demand for mobility. As income increases, spending on travel also increase (the TMB defines the proportion), allowing for greater mobility (i.e. TV). The relationship between GDP per capita and TV per capita is thus given by:

$$\frac{TV}{cap} = \log\left(\frac{GDP/cap}{g} - h\right) * \left(\frac{GDP}{cap}\right)^{e} * f^{*} \tag{1}$$

and,

$$f^{*} = \frac{240{,}000^{1-e}}{\log\left(\frac{240{,}000}{g} - h\right)} \tag{2}$$

where,

f^* represents the money people spend on transport (the TMB) and the inverse unit cost of transport (pkm/USD), which is calibrated when future TV is set as 240,000 km/cap and future income (GDP/cap) is set as 240,000 USD/cap (see detailed calibration in Schafer and Victor, 2000).

g & h: parameters required calibration to better fitting with the data set $\{GDP, TV\}$

From Eq.(1), the future TV per capita can be calculated given the parameters of g and h. Multiplying the projected population, we can derive the future total TV, i.e., total PMT in a specific region, such as the GCM area. Notably, the best way to apply these equations to the GCM would be first estimating the GCM's parameters using corresponding data. However, there're no historical data on total passenger traffic volume and travel mode share in the whole GCM area. Thus, we use the second best solution for this project: the parameters derived by Schafer and Victor (2000) for North America region were used directly without modification, as in Table 3.2.

Table 3. 1 Model Parameters

e	g	h	i	j	k	l	m	t	u
0.776	40.2	61.19	122.7	6262	1	1195	-3248	4.82*10-5	35684

Third, after achieving the future *TV* and per capita *TV* in the second step, one can predict the future mode split of existing or potential transport modes, including automobile, rail way, bus, and high-speed travel by airplane or HSR. Similar to Zhang and Chen, the share of ordinal railway (S_{Rail}), bus (S_{Bus}), high-speed travel (S_{HST}), and automobile (S_{Auto}) are calculated as follows:

$$S_{Rail} = i * \left(\frac{1}{(TV - j)^k} - \frac{1}{(240{,}000 - j)^k} \right) \qquad (3)$$

$$S_{Bus} = l * \left(\frac{1}{(TV - m)} - \frac{1}{(240{,}000 - m)} \right) - S_{Rail} \quad (4)$$

$$S_{HST} = s * \exp\{-\exp[-t * (TV / cap - u)]\} + v \quad (5)$$

$$S_{Auto} = 1 - S_{Rail} - S_{Bus} - S_{HST} \quad (6)$$

where, *i, j, k, l, m, t, u* are preset parameters with their values shown in Table 3.2;

s is a parameter calculated in following equation:

$$s = \frac{S_{HST,2050} - 1}{\exp\{-\exp[-t * (TV_{2050} / cap - u)]\} - \exp\{-\exp[-t * (240{,}000 - u)]\}} \quad (7)$$

$S_{HST,2050}$ representing the share for high speed transport in 2050, affected by other transport mode:

$$S_{HST,2050} = \frac{1 - S_{Bus} * (1 - V_{Auto} / V_{Bus}) - S_{Rail} * (1 - V_{Auto} / V_{Rail}) - V_{Auto} * TTB_{mot} * 365 / TV}{(1 - V_{Auto} / V_{HST})} \quad (8)$$

$V_{Auto}, V_{Bus}, V_{Rail}, V_{HST}$ are the predicted travel speed by automobile, bus, rail, and high speed travel mode in 2050, which are set as 55km/hr, 20km/hr, 30km/hr, and 600km/hr (Schafer and Victor, 2000);

TTB_{mot} is the fixed travel time budget by motorized modes, as 1.1 hour;

v is a parameter calculated in following equation:

$$v = 1 - s * \exp\{-\exp[-t * (240{,}000 - u)]\} \quad (9)$$

3.2 Projection of Future Population

The population projection from 2010 to 2050 for Texas counties come from TxSDC. However, such population projections are not readily available for most of the counties outside Texas in GCM. Only 2010 census data of population exist in these counties outside Texas. Another assumption is thus made: the population growth rate of the county outside Texas is assumed to equal the average growth rate of the entire Texas area. Under this assumption, we project the future population of each county in the GCM area based on the 2010 population, multiplying the average population growth rate.

Figure 3.2 presents the projected population from 2010 to 2050 in the entire GCM area with different scenarios of net migration rate. The higher the net migration rate, the larger the population grows. For example, when the net migration rate is assumed as 0, population growth only relies on natural increase. The projected population reaches 17.6 million by 2050, 32% higher than GCM's population in 2010. When the net migration rate is assumed as 0.5, the net migration rate after 2010 is assumed to be half of that in the 2000s. In this case, the projected population in 2050 is 22.8 million, 70% higher than the 2010 population. When the net migration rate equals one, the net migration rate after 2010 is assumed to be the same as that in the 2000s. The projected population in 2050 is the largest, close to 30 million and 120% higher than the 2010 population.

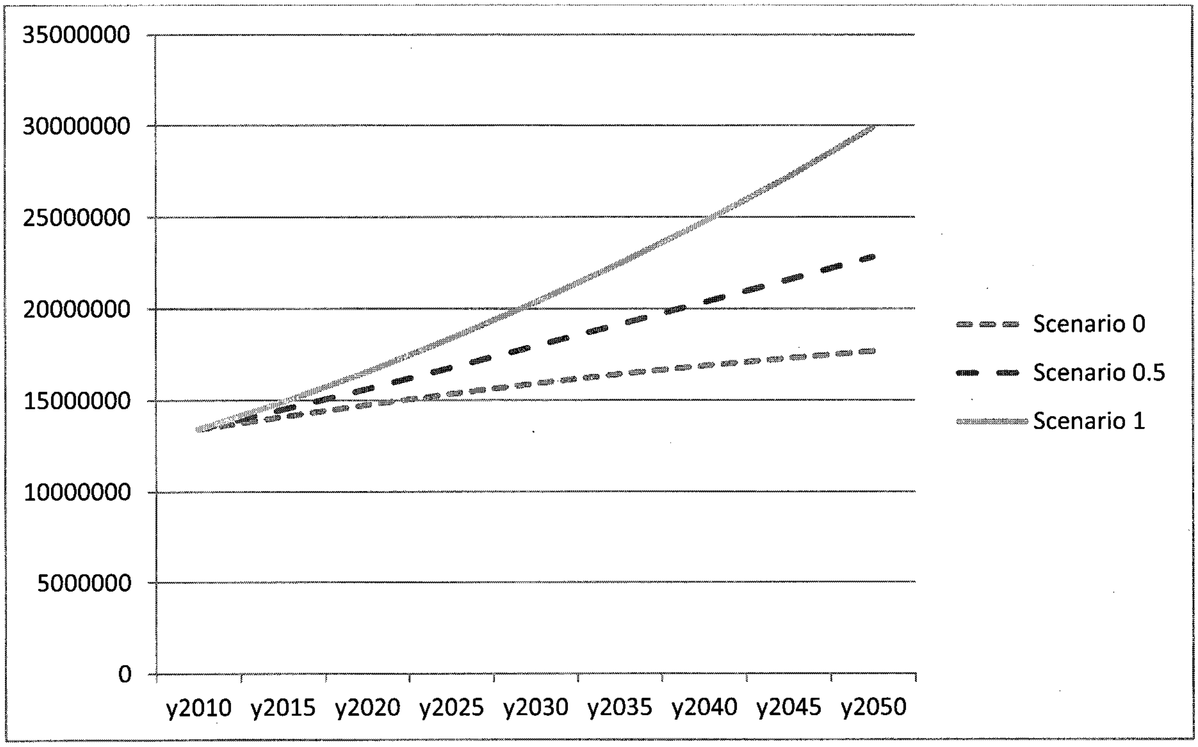
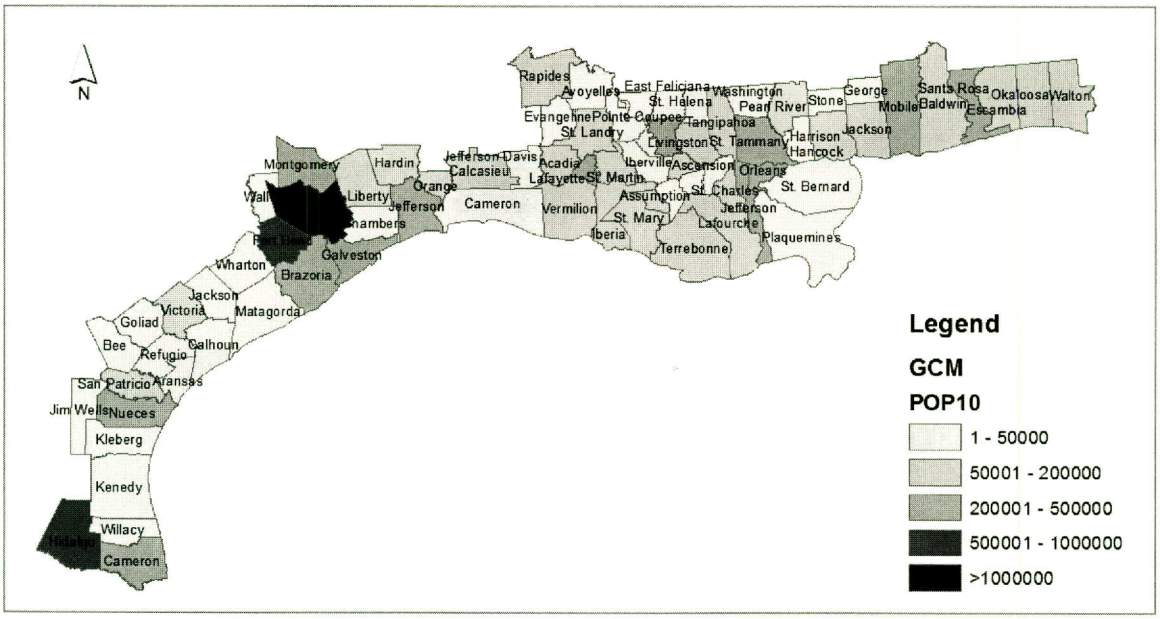
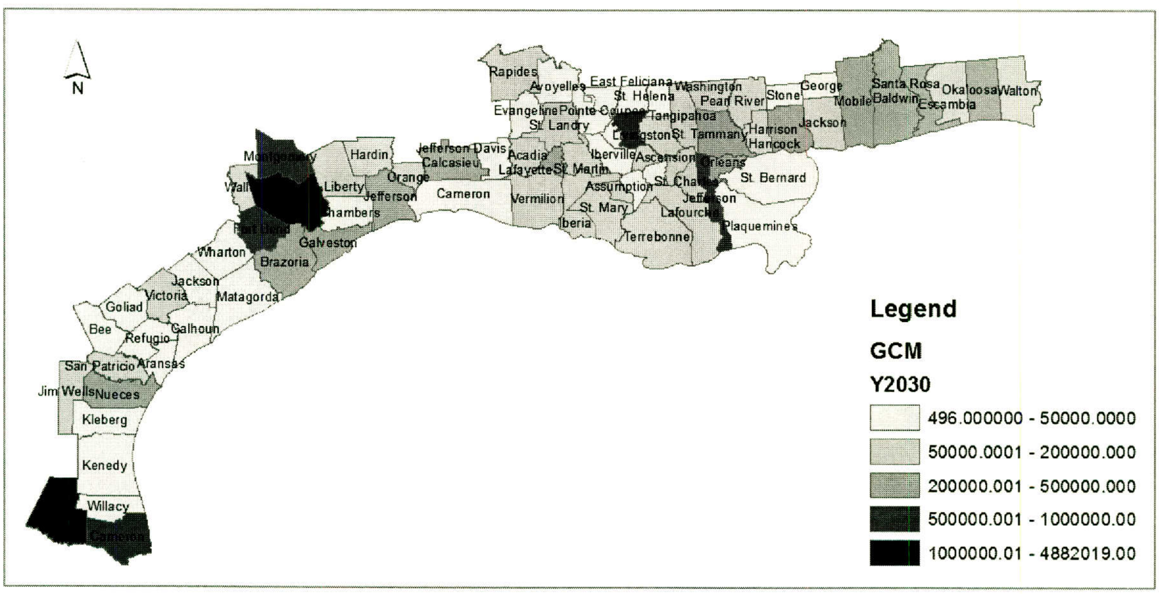


Figure 3. 1 Projected Population from 2010 to 2050 in GCM with different scenarios

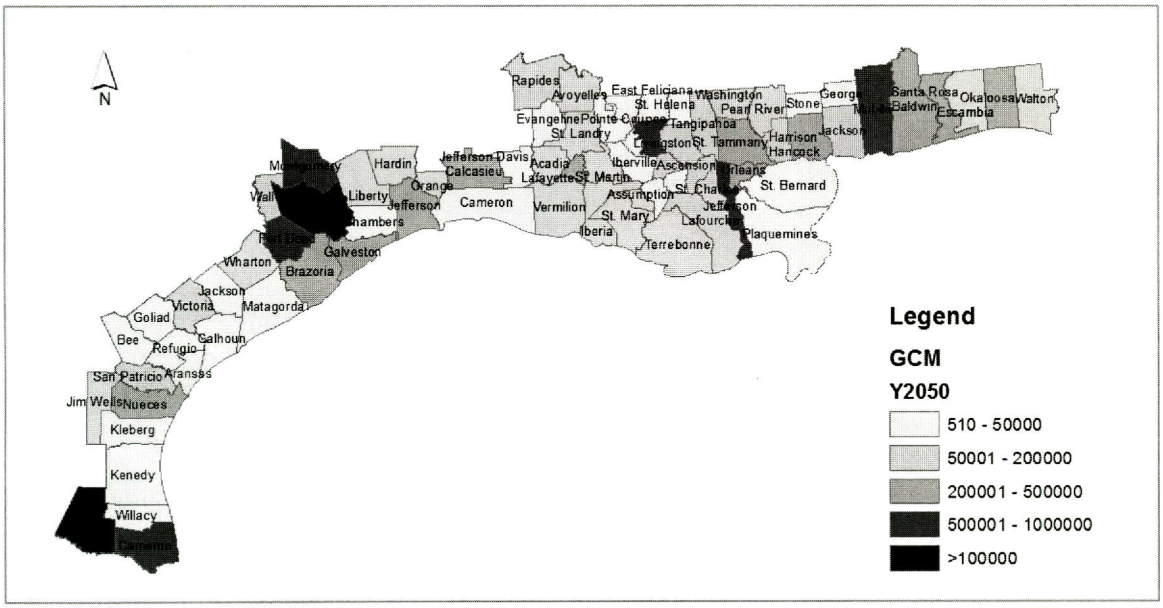
Figure 3.3 shows the geographical distribution of existing and projected population in 2010, 2030, and 2050 in the GCM area. Along the gulf coast, the current population mainly centers on the Houston-Sugar Land-Baytown MSA (including Harris County). The McAllen-Edinburg-Mission MSA (including Hidalgo County) in Texas, Tampa-St. Petersburg-Clearwater MSA in Florida, New Orleans-Metairie-Kenner MSA in Louisiana, and Baton Rouge-Pierre Part CSA in Louisiana are fast developing areas, which are abstracting increasing population and becoming regional sub-centers in 2050 GCM. The population projection in this report demonstrates that the numbers of county with more than 50,000 residents will increase from three in 2010 to eight in 2050, when the net migration is presumed as 0. When the net migration rate is 1, the corresponding numbers of county with over 50,000 populations will reach 12. These findings indicate that increasing regional sub-centers will be emerged in the GCM area in the forthcoming decades; and thus, inter-regional travel demand (which often falls into long-distance travel demand by the conventional approach) will grow when the sub-centers emerge and grow.



(a) Population in 2010 (from census)



(b) Population in 2030 (Projection)



(c) Population in 2050 (Projection)

Figure 3. 2 Population changes in the GCM area from 2010 to 2005 (zero net migration assumed)

3.3 Projection of Future GDP

In 2007, the Global Economics Report from the GS Institutional Portal (2007) projected national GDP from 2010 to 2050 of eleven largest economies in the world, based on data from US Census Bureau International Database. As estimated, the US GDP is more than $14,000 billion in 2010 (in 2006 US$), and will rise to about 39,000 billion in 2050 (in 2006 US$). This projection implies that the average annual growth rate of GDP is about 1.5% in the US from 2010 to 2050.

The projection of future mobility in the GCM area requires data of future GDP in the GCM area. In order to estimate county-level GDP growth, we applied a ratio-share projection method. By the method we first estimate each year's share of each county's GDP in the US. Since there are no official data for GDP projection at neither the county level nor the megaregional level, we use the share of each county's personal income among the entire US personal income to represent the GDP share. The personal income data is sourced from Bureau of Economic Analysis (BEA, 2012), which provides aggregate income data of each county and the entire US.

Two types of GDP projections are introduced here. First, the income shares are assumed to be constant during the period projected (labeled as GDP Constant in Table 3.3). Second, the income shares (labeled as GDP_Increasing in Table 3.3) are assumed to grow in a constant rate that equals to the average increasing rate of income shares in the 2000s. In this case, the share of GCM's total personal income in the entire US personal income will increase from 2010 to 2050, as shown in Figure 3.4. In 2010, the share of GCM's total personal income among the entire US's is 4.24%. In 2050, the corresponding number rises to 6.25%.

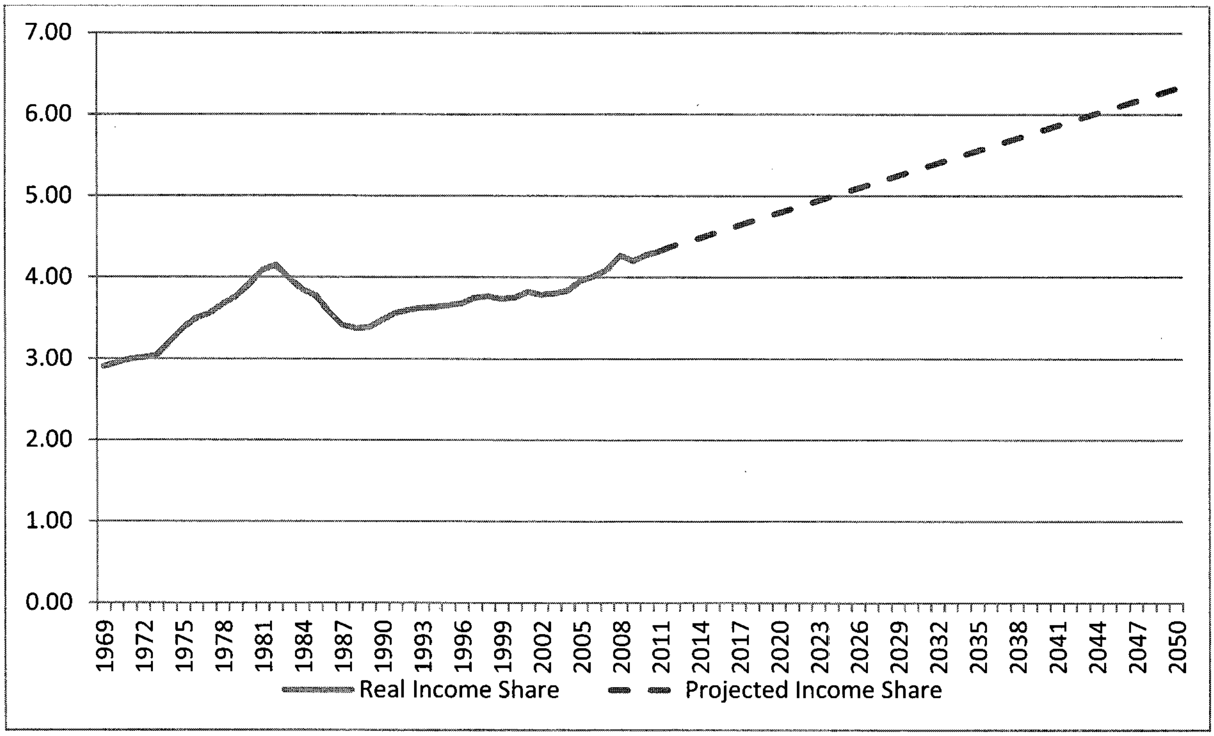


Figure 3. 3 The share of GCM's total personal income in the entire US personal income from 1969 to 2010 and the projected income share from 2011 to 2050.

In summary, the projected population and GDP from 2010 to 2050 for GCM are shown in Table 3.2. There are two series of GDP projections and three series of population projections. They generate six projection scenarios of per capita GDP in the GCM area.

Table 3. 2 Estimated GDP (USD 2006) and population in the GC megaregion

Year	GDP_Constant IS (billion)	GDP_Increasing IS (billion)	POP_0 (million)	POP_0.5 (million)	POP_1 (million)
2010	622.10	622.10	13.41	13.41	13.41
2015	693.10	733.59	14.10	14.50	14.90
2020	769.46	861.15	14.74	15.61	16.55
2025	859.72	1014.39	15.35	16.77	18.37
2030	976.57	1209.30	15.91	17.95	20.34
2035	1116.95	1448.38	16.42	19.14	22.45
2040	1276.42	1732.72	16.88	20.34	24.72
2045	1451.09	2054.58	17.29	21.56	27.19
2050	1648.40	2434.08	17.67	22.82	29.89

3.4 Projection of Future Mobility

As noted in the methodology section, a region's future mobility is estimated based on the projection of per capita GDP. In this section, the projected population is estimated based on zero net migration assumption, i.e., POP_0, and the projected GDP projection is estimated based on constant income share assumption, i.e., GDP_Constant. The next section will present the sensitivity analysis with alternative projected GDP or population by different methods of estimation.

Table 3.4 shows the projected mobility (including per capita traffic volume and total TV) in the entire GCM area in five years intervals from 2010 to 2050. The per capita TVs are projected to rise from 33548 mile/cap in 2010 to 63691 mile/cap in 2050, a net increase of 90% TV/cap within 40 years. Since the population will also grow fast in the GCM area, the total TV in 2050 is projected to be 105 billion mile, four times of total TV in 2010. These projection results demonstrate that an increasing growth of population and economy in the future GCM area is associated with increasing travel demand in the megaregion.

Table 3. 3 Projected mobility in the GCM area (GDP_Constant IS & POP_0)

Year	TV/Cap (mile)	Total TV (million mile)
2010	33548	20870
2015	35406	24540
2020	37427	28798
2025	39941	34339
2030	43447	42429
2035	47740	53323
2040	52604	67145
2045	57856	83954
2050	63691	104988

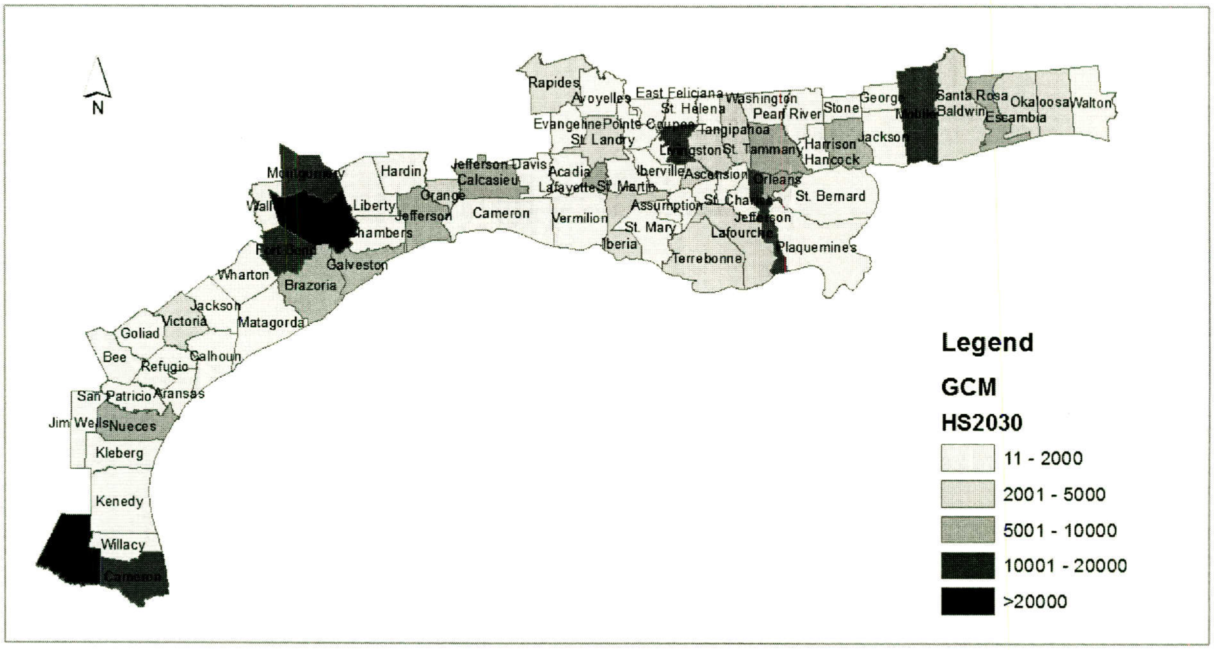
Table 3.5 provides more detailed projection of mobility demand by different modes, including rail, bus, car, and high speed travel mode like high-speed rail or airplane. Although the total travel by rail and bus would continue to grow, their shares are likely to decrease. In contrast, both the total travel and the share of high-speed transport are expected to increase. By 2050, the share of high-speed transport will reach up to 89%, and the mileage traveled by high-speed modes would be about 10 times as much as 2010. The total travel by car would decrease from 2010 to 2050. The percentage share of car for travel would drop from 89% in 2010 to 10% in 2050. The projection results strongly suggest the importance of supplying high-speed transport services in the future.

Table 3. 4 Estimated mode share and total travel demand by mode in the GCM area (GDP_Constant IS & POP_0)

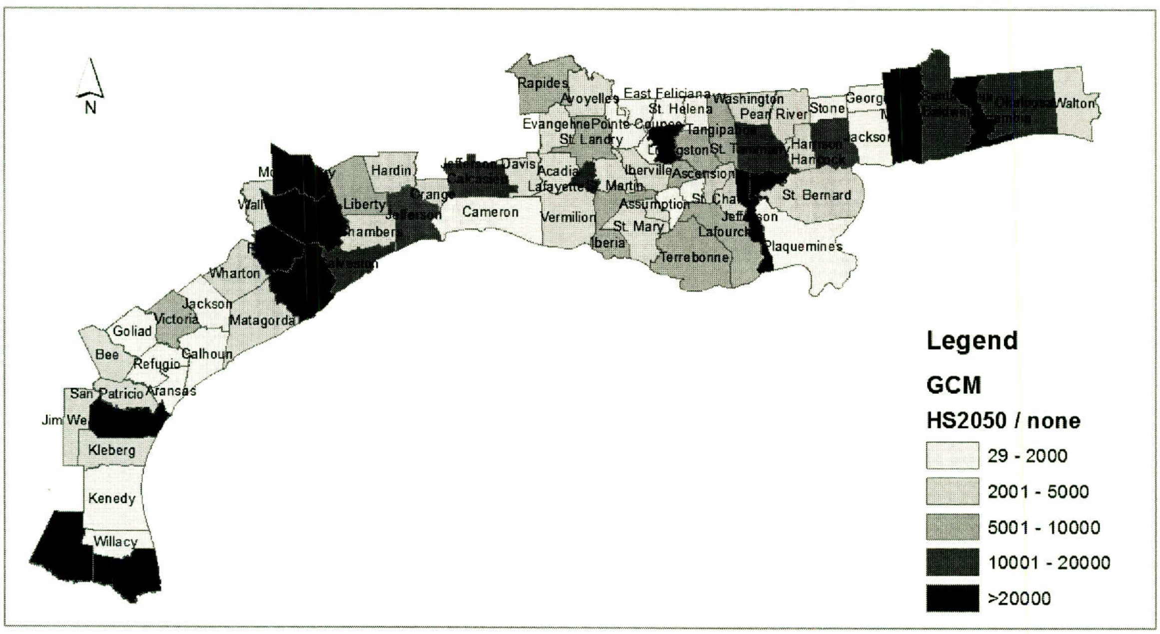
Year	Rail		Bus		Car		HST	
	Share (%)	total TV (mil mile)	Share (%)	total TV (mil mile)	Share (%)	total TV (mil mile)	Share (%)	total TV (mil mile)
2010	0.20	921	1.79	8046	88.90	400113	9.10	40969
2015	0.19	946	1.66	8265	78.92	394033	19.23	96020
2020	0.17	965	1.53	8431	69.06	381049	29.24	161304
2025	0.16	975	1.39	8519	58.20	356833	40.25	246783
2030	0.14	970	1.23	8474	45.49	314497	53.15	367430
2035	0.12	952	1.06	8317	33.30	261081	65.52	513741
2040	0.10	924	0.91	8072	23.13	205420	75.85	673582
2045	0.09	888	0.78	7762	15.45	154544	83.69	837146
2050	0.08	844	0.66	7378	9.76	109833	89.51	1007574

3.5 Future Demand of High Speed Travel

Previous analyses on the high-speed travel demand (Table 3.5) suggest an increasing trend of travel by high-speed transport (HST). By 2050, the total estimated TV by HST would largely grow to 1007 billion mile, about 25 times of the 2010. Figure 3.5 provides the geographical distribution of the HST mobility demand in 2030 and 2050. Comparing these two figures, the development of this megaregion would generate increasing HST demand, and they are mainly generated in the areas with larger population. If a high-speed rail would be built along the gulf coast, five potential station locations would be recommended as shown in Figure 3.5(b). These stations may locate in five counties, including Hidalgo, Nueces, Harris, Livingston, and Rosa from west to east. These counties and their adjacent counties occupy about 70 percentage of total HST demand.



(a) Projected high-speed travel demand in GCM (2030)



(b) Projected high-speed travel demand in GCM (2050)

Figure 3. 4 Projected high-speed travel demand in GCM in 2030 and 2050

3.6 Sensitive Analysis

The results reported in Sections 3.3 and 3.4 rely on the assumptions pertaining to population and GDP growth. When the assumptions or rules of population and GDP projection change, the projected results will change accordingly. The model used in previous analysis is thus not fully deterministic. In this part of analysis we modify assumed values/parameters to test the sensitivity of our projection results (three population projection series and two GDP projection series).

Table 3.6 presents the projected future mobility when the assumption of constant income share is held and the net migration rate is set as 0.5 (GDP_Constant IS & POP_0.5). In this case, the general tendency of TV and mode split are similar to the results in Section 3.3 (GDP_Constant IS & POP_0). For example, both per capita TV and total TV would be raised from 2010 to 2050; the share of HST would increase while those of all other modes would decrease. Similar results could be found in Table 3.7, in which the net migration rate is set as 1 (GDP_Constant IS & POP_1).

Table 3. 5 Projection of future mobility (GDP_Constant IS & POP_0.5)

Year	TV/Cap (mile/cap)	Total TV (mil mile)	S_Rail	S_Bus	S_Car	S_HST
2010	33548	450049	0.20	1.79	49.98	48.03
2015	34514	500289	0.20	1.72	46.98	51.11
2020	35497	554149	0.19	1.65	44.07	54.09
2025	36811	617321	0.18	1.57	40.39	57.86
2030	38887	698020	0.17	1.45	35.08	63.31
2035	41484	793960	0.15	1.31	29.26	69.28
2040	44348	902015	0.14	1.19	23.81	74.86
2045	47290	1019535	0.12	1.08	19.16	79.64
2050	50443	1151299	0.11	0.97	15.10	83.81

Table 3. 6 Projection of future mobility (GDP_Constant IS & POP_1)

Year	TV/Cap (mile/cap)	Total TV (mil mile)	S_Rail	S_Bus	S_Car	S_HST
2010	33548	450049	0.20	1.79	32.93	65.08
2015	33647	501300	0.20	1.78	32.72	65.29
2020	33633	556545	0.20	1.78	32.75	65.26
2025	33834	621540	0.20	1.77	32.33	65.70
2030	34642	704687	0.20	1.71	30.69	67.41
2035	35804	803844	0.19	1.63	28.43	69.76
2040	37051	916041	0.18	1.55	26.15	72.13
2045	38204	1038741	0.17	1.48	24.16	74.18
2050	39381	1176967	0.16	1.42	22.27	76.15

Results in Tables 3.4-3.7 show strong influences of assumptions for population projections on projections of mobility demand. The larger the population level projected in 2050, the fewer the per capita traffic volume generated, holding income share constant. But the total TV would increase when more population is projected. Increasing population by 30% in 2050 would obviously raise the shares of rail, bus and car modes by 38%, 47%, and 55%, but slightly decrease the share of HST by 6%. Similarly, increasing population by 70% in 2050 would raise the shares of rail, bus, and car by 100%, 109%, and 124%, but decrease the share of HST by 15%. These sensitivity analyses suggest that high-speed transport is unlikely to replace the traditional low-speed transport in a megaregion with a large population.

Table 3.8 shows the results of projected mobility when the projected GDP is estimated by increasing income share and the net migration rate equals 1 (i.e., GDP_Increasing IS & POP_1). By comparing Table 3.7 and 3.8, increasing the GCM's GDP share would generally decrease the proportions of using rail, bus, or car, but increase the share of HST. If the GCM area plays an increasingly important role in the US economy in future, it needs more high-speed infrastructure to meet increasing HST demand.

Table 3. 7 Projection of future mobility (GDP_Increasing IS & POP_1)

Year	TV/Cap (mile/cap)	Total TV (mil mile)	S_Rail	S_Bus	S_Car	S_HST
2010	33548	450049	0.20	1.79	64.12	33.88
2015	35463	528357	0.19	1.65	56.69	41.47
2020	37324	617635	0.18	1.53	50.11	48.18
2025	39423	724217	0.16	1.42	43.44	54.98
2030	42195	858335	0.15	1.28	35.78	62.80
2035	45486	1021218	0.13	1.14	28.22	70.51
2040	49073	1213282	0.12	1.02	21.63	77.23
2045	52573	1429434	0.10	0.91	16.59	82.40
2050	56294	1682445	0.09	0.81	12.44	86.66

4. Conclusion

Megaregions are playing an increasingly critical role in regional and global economic competition. About three fourth of national population and wealth are concentered in the megaregional areas that occupy one fourth of the land areas in the US. Projections indicate the continuing leading role of megaregions in future population and economic growth. NHTS reveal that megaregions also concentrate current and future mobility demand. Megaregions' major MSAs contributed to 32% of total PMT in the US in 2001. The figure grew up to 45% in 2009. Travelers in the megaregions have longer average travel time, lower travel speed, and thus likely experience more serious traffic congestion than non-megaregional areas. Nevertheless, people living in the megaregions drive less and rely more on public transit, walking, and bicycling. The growing importance of megaregions calls for megaregional approach to future transportation planning and policy making that goes beyond the conventional jurisdictions of individual MPOs.

This report presents a method that utilizes aggregate data for mobility study (for both passenger and freight) in a megaregional scale. The method is used to project future mobility demand in the Gulf Coast megaregion (GCM), an extension to previous study on the Texas Triangle megaregion (Zhang and Chen, 2009). The descriptive analysis of multi-year NHTS data reveals some unique characteristics of travel in the GCM area. GCM exhibits a contrary trend to the nation in travel. While traffic condition measured by average travel speed in most megaregions showed improvements from 2001 to 2009, it became worse off in GCM. Driving share increased in the US; yet in GCM, driving decreased and walking and bicycling increased. These findings suggest further studies needed to better understand travel in GCM. A preliminary analysis on freight flow was also conducted for the GCM areas. Utilizing the 2002 and 2007 CFS data, the freight analysis demonstrates that the freight demand in the GCM area is fast growing. It is especially the case that shipment by airplanes has a very limited share and rail keeps its significant role from and to GCM.

Overall, the study shows that the GCM area would experience an enormous amount of mobility growth by year 2050. This is evident when the growth of population and GDP are projected in moderate rates (i.e., by assuming zero net migration from 2010 to 2050 and constant GDP share in the entire US). The per capita traffic volume generated by each traveler in 2050 would double the 2010 level. The total traffic volume in 2050 would grow much faster, four times of mileages higher than the 2010.

The projection of mode split in the GCM area reveals a general trend that the share of HST would significantly increase while those of all other conventional low-speed modes, including rail, bus, and car, would decrease to some degree. Based on the moderate assumptions of population and GDP growth, the share of HST was projected to grow up to 89% while the share of driving would fall to 10% by 2050, although the total TV by both car and HST would increase in magnitude. The higher the projected GDP in 2050, the bigger share of travel demand goes to HST.

The projected trends of future travel demand indicate a growing pressure on the transportation infrastructure in the GCM area. Currently air transportation offers the only high-speed mode of inter-city travel. By year 2050, high-speed travel demand would rise to about 10 times of the year 2010 level. It is unlikely that the demand for high-speed travel can all be met by air travel because of the capacity constraints in airway networks, gates and runways, and airport operations. Accordingly, planning for megaregional transportation should seriously consider high-speed travel in the form of High Speed Rail (HSR) to accommodate the future travel demand in the GCM area. If such a HSR would be built along the gulf coast, our result suggests five potential stations in five counties, including Hidalgo, Nueces, Harris, Livingston, and Rosa from west to east. More than 70% of total HST demand is generated in these counties and their adjacent counties.

Several limitations exist in the study. First, the projection results highly depend on, and therefore sensitive to the way that population and GDP are projected. The errors in the projection of population and GDP would be propagated to mobility projection. Second, most of these projections are based on spatial units such as nation, state, or MSA. Few data sources are available at the megaregional level. This insufficiency in data sources may make the megaregional approach difficult or costly to practice. Third, the models used for mobility projection in this study are built on a number of strong assumptions on several critical parameters, for instance, the assumption of fixed travel time budget (TTB) and fixed travel money budget (TMB), and the preset speed of rail, bus, car, and HST. Setting different values of these parameters would lead to different projection results of future mobility. Particular caution must be exercised when the method is applied to small geographical regions.

Appendix

Table A. 1 Overall outbound freight value of CFS areas in 11 megaregions in 2007

Origins (CFS Areas)	Destinations				
	Freight Values to the same CFS area (million $)	Freight Values to other CFS areas inside the same Mega (million $)	Freight Values to other CFS areas in other Megas (million $)	Freight Values to overall US regions(million $)	Percent of freight values delivering to CFS areas inside 11 Megas (%)
Gulf Coast					
Baton Rouge-Pierre Part, CFS Area	30329	16071	7282	77631	69.15
Beaumont-Port Arthur, CFS Area	38469	14577	6870	79852	75.03
Corpus Christi-Kingsville, CFS Area	10755	8585	11350	41027	74.80
Houston-Baytown-Huntsville, CFS Area	246820	10879	58300	410343	77.01
Lake Charles-Jennings, CFS Area	13681	4131	1137	22432	84.47
Mobile-Daphne-Fairhope, CFS Area	3096	417	2151	15246	37.15
New Orleans-Metairie-Bogalusa, CFS Area	36760	26135	7011	98546	70.94
Texas Triangle					
Austin-Round Rock, CFS Area	13274	6025	3550	56170	40.68
Dallas-Fort Worth, CFS Area	96610	9221	73866	271664	66.15
San Antonio, CFS Area	43332	7599	4057	85066	64.64
Southern Florida					
Jacksonville, CFS Area	13273	8375	7926	46699	63.33
Miami-Fort Lauderdale-Pompano Beach, CFS Area	78885	5594	17805	126797	80.67
Orlando-Deltona-Daytona Beach, CFS Area	21282	15152	5070	64905	63.95
Tampa-St. Petersburg-Clearwater, CFS Area	27929	10464	12715	70579	72.41
Southern California					
Las Vegas-Paradise-Pahrump, CFS Area	11461	2072	3225	22789	73.54
San Diego-Carlsbad-San Marcos, CFS Area	22295	2845	33391	87301	67.05
Los Angeles-Long Beach-Riverside, CFS Area	378196	11515	219694	758517	80.34
North California					
Sacramento--Arden-Arcade--Yuba City, CA-NV, CFS Area (CA part)	19607	723	18947	66589	58.98
San Jose-San Francisco-Oakland, CFS Area	133274	6091	70866	270110	77.83
Front Range					
Denver-Aurora-Boulder, CFS Area	33901	0	16951	87761	57.94
Cascadia					
Portland-Vancouver-Beaverton, OR-WA, CFS Area (OR part)	33627	198	28141	96082	64.49

Seattle-Tacoma-Olympia, CFS Area	60151	632	25589	145420	59.39
Arizona Sun Corridor					
Phoenix-Mesa-Scottsdale, CFS Area	49464	6942	30418	130489	66.54
Tucson, CFS Area	3802	2240	3365	19126	49.18
Piedmont Atlantic					
Atlanta-Sandy Springs-Gainesville, GA-AL, CFS Area (GA part)	84706	17803	52396	243052	63.73
Birmingham-Hoover-Cullman, CFS Area	12977	2309	5843	48966	43.15
Charlotte-Gastonia-Salisbury, NC-SC, CFS Area (NC part)	33596	10348	13636	93147	61.82
Greensboro--Winston-Salem--High Point, CFS Area	24362	9728	24569	95778	61.24
Greenville-Spartanburg-Anderson, CFS Area	10505	5258	12964	53321	53.88
Raleigh-Durham-Cary, CFS Area	11763	3721	13142	55985	51.13
Richmond, CFS Area	18633	1569	10178	48296	62.90
Northeast					
Albany-Schenectady-Amsterdam, CFS Area	14211	14103	4951	50493	65.88
Baltimore-Towson, CFS Area	22022	11842	22893	77119	73.60
Boston-Worcester-Manchester, MA-RI-NH, CFS Area (MA part)	62135	32826	37334	182723	72.40
Boston-Worcester-Manchester, MA-RI-NH, CFS Area (RI part)	5945	10198	4491	28662	71.99
Hartford-West Hartford-Willimantic, CFS Area	12712	27890	8652	67414	73.06
New York-Newark-Bridgeport, NY-NJ-CT-PA, CFS Area (CT part)	16383	20469	8933	67530	67.80
New York-Newark-Bridgeport, NY-NJ-CT-PA, CFS Area (NJ part)	88754	87956	72266	327046	76.13
New York-Newark-Bridgeport, NY-NJ-CT-PA, CFS Area (NY part)	115399	53615	72374	292789	82.44
Philadelphia-Camden-Vineland, PA-NJ-DE-MD, CFS Area (NJ part)	12809	39505	13630	89416	73.75
Philadelphia-Camden-Vineland, PA-NJ-DE-MD, CFS Area (PA part)	33990	35288	29458	139642	70.71
Washington-Arlington-Alexandria, DC-VA-MD-WV, CFS Area (DC part)	1590	734	325	2876	92.11
Washington-Arlington-Alexandria, DC-VA-MD-WV, CFS Area (MD part)	5877	7752	10865	32684	74.94
Washington-Baltimore-Northern Virginia, DC-MD-VA-WV, CFS Area (VA part)	8408	4137	7376	31535	63.17
Great Lake					
Buffalo-Niagara-Cattaraugus, CFS Area	17658	7010	11153	57294	62.52
Chicago-Naperville-Michigan City, IL-IN-WI, CFS Area (IL part)	155615	68571	78266	436947	69.22
Chicago-Naperville-Michigan City, IL-IN-WI, CFS Area (IN part)	10275	11596	2904	38985	63.55
Cincinnati-Middletown-Wilmington, OH-KY-IN, CFS Area (OH part)	15755	19386	9368	84458	52.70
Cleveland-Akron-Elyria, CFS Area	30432	23771	18770	113500	64.29
Columbus-Marion-Chillicothe, CFS Area	20477	26350	29728	126557	60.49
Dayton-Springfield-Greenville, CFS Area	7629	18453	3739	59003	50.54

Detroit-Warren-Flint, CFS Area	90135	30224	37993	239881	66.01
Grand Rapids-Muskegon-Holland, CFS Area	14438	15125	10413	65134	61.38
Indianapolis-Anderson-Columbus, CFS Area	21187	19002	16559	103563	54.80
Louisville/Jefferson County-Elizabethtown-Scottsburg, KY-IN, CFS Area (KY part)	30755	9374	8458	72107	67.38
Milwaukee-Racine-Waukesha, CFS Area	17721	20495	12637	85504	59.47
Minneapolis-St. Paul-St. Cloud, MN-WI, CFS Area (MN part)	58940	18514	32291	171728	63.91
Pittsburgh-New Castle, CFS Area	33213	17326	15335	99709	66.07
Rochester-Batavia-Seneca Falls, CFS Area	12039	5424	11251	47205	60.83
St. Louis-St. Charles-Farmington, MO-IL, CFS Area (IL part)	7075	12496	1213	32583	63.79
St. Louis-St. Charles-Farmington, MO-IL, CFS Area (MO part)	27785	11809	14977	93534	58.34

Table A. 2 Outbound freight value by mode of CFS areas in 11 megaregions in 2007

Origins (CFS Areas)	Truck (%)	Rail (%)	Air (%)	Others (%)
Gulf Coast				
Baton Rouge-Pierre Part, CFS Area	33.67	17.15	NA	NA
Beaumont-Port Arthur, CFS Area	25.56	16.24	0.02	58.18
Corpus Christi-Kingsville, CFS Area	18.68	2.38	NA	NA
Houston-Baytown-Huntsville, CFS Area	48.30	11.88	NA	NA
Lake Charles-Jennings, CFS Area	29.41	19.91	NA	NA
Mobile-Daphne-Fairhope, CFS Area	66.13	16.59	0.24	17.03
New Orleans-Metairie-Bogalusa, CFS Area	21.74	7.53	0.28	70.45
Texas Triangle				
Austin-Round Rock, CFS Area	74.50	0.06	NA	NA
Dallas-Fort Worth, CFS Area	72.38	0.24	3.35	24.04
San Antonio, CFS Area	63.87	0.47	0.14	35.52
Southern Florida				
Jacksonville, CFS Area	81.39	0.65	NA	NA
Miami-Fort Lauderdale-Pompano Beach, CFS Area	76.91	0.34	2.26	20.49
Orlando-Deltona-Daytona Beach, CFS Area	76.58	0.05	1.94	21.43
Tampa-St. Petersburg-Clearwater, CFS Area	75.97	0.65	1.86	21.52
Southern California				
Las Vegas-Paradise-Pahrump, CFS Area	82.73	0.01	NA	NA
Los Angeles-Long Beach-Riverside, CFS Area	67.61	0.73	2.26	29.40
San Diego-Carlsbad-San Marcos, CFS Area	60.12	NA	4.20	NA
North California				
Sacramento--Arden-Arcade--Yuba City, CA-NV, CFS Area (CA part)	73.25	0.85	2.00	23.90
San Jose-San Francisco-Oakland, CFS Area	53.15	0.57	9.02	37.26
Front Range				

Denver-Aurora-Boulder, CFS Area	68.56	1.80	4.91	24.73
Cascadia				
Portland-Vancouver-Beaverton, OR-WA, CFS Area (OR part)	65.99	1.32	0.00	32.69
Seattle-Tacoma-Olympia, CFS Area	57.72	0.80	NA	NA
Arizona Sun Corridor				
Phoenix-Mesa-Scottsdale, CFS Area	73.63	0.00	5.46	20.91
Tucson, CFS Area	75.08	7.77	0.00	17.15
Piedmont Atlantic				
Atlanta-Sandy Springs-Gainesville, GA-AL, CFS Area (GA part)	82.44	0.51	1.74	15.31
Birmingham-Hoover-Cullman, CFS Area	69.27	4.12	0.43	26.18
Charlotte-Gastonia-Salisbury, NC-SC, CFS Area (NC part)	85.42	0.43	0.29	13.87
Greensboro--Winston-Salem--High Point, CFS Area	86.01	NA	NA	NA
Greenville-Spartanburg-Anderson, CFS Area	82.94	NA	0.53	NA
Raleigh-Durham-Cary, CFS Area	78.06	0.17	NA	NA
Richmond, CFS Area	85.35	2.48	0.28	11.89
Northeast				
Albany-Schenectady-Amsterdam, CFS Area	74.89	NA	1.10	NA
Baltimore-Towson, CFS Area	81.87	1.21	NA	NA
Boston-Worcester-Manchester, MA-RI-NH, CFS Area (MA part)	68.43	0.20	4.29	27.08
Boston-Worcester-Manchester, MA-RI-NH, CFS Area (RI part)	78.97	0.00	1.66	19.37
Hartford-West Hartford-Willimantic, CFS Area	80.46	0.00	1.50	18.05
New York-Newark-Bridgeport, NY-NJ-CT-PA, CFS Area (CT part)	66.43	0.60	NA	NA
New York-Newark-Bridgeport, NY-NJ-CT-PA, CFS Area (NJ part)	70.27	NA	2.60	NA
New York-Newark-Bridgeport, NY-NJ-CT-PA, CFS Area (NY part)	65.94	NA	2.50	NA
Philadelphia-Camden-Vineland, PA-NJ-DE-MD, CFS Area (NJ part)	76.29	2.13	1.08	20.49
Philadelphia-Camden-Vineland, PA-NJ-DE-MD, CFS Area (PA part)	66.07	2.70	NA	NA
Washington-Arlington-Alexandria, DC-VA-MD-WV, CFS Area (DC part)	83.69	0.00	0.07	16.24
Washington-Arlington-Alexandria, DC-VA-MD-WV, CFS Area (MD part)	71.93	0.22	0.00	27.85
Washington-Baltimore-Northern Virginia, DC-MD-VA-WV, CFS Area (VA part)	76.39	0.26	3.14	20.21
Great Lake				
Buffalo-Niagara-Cattaraugus, CFS Area	71.66	2.38	1.03	24.93
Chicago-Naperville-Michigan City, IL-IN-WI, CFS Area (IL part)	67.92	2.00	1.67	28.40
Chicago-Naperville-Michigan City, IL-IN-WI, CFS Area (IN part)	75.93	12.67	0.43	10.97
Cincinnati-Middletown-Wilmington, OH-KY-IN, CFS Area (OH part)	82.93	4.00	1.00	12.07
Cleveland-Akron-Elyria, CFS Area	78.54	1.34	1.19	18.93
Columbus-Marion-Chillicothe, CFS Area	68.53	3.56	0.21	27.69
Dayton-Springfield-Greenville, CFS Area	79.30	0.00	0.58	20.12
Detroit-Warren-Flint, CFS Area	69.55	12.20	0.32	17.93
Grand Rapids-Muskegon-Holland, CFS Area	83.03	0.45	2.32	14.20
Indianapolis-Anderson-Columbus, CFS Area	78.34	2.62	NA	NA
Louisville/Jefferson County-Elizabethtown-Scottsburg, KY-IN, CFS Area (KY part)	69.52	1.76	0.61	28.12
Milwaukee-Racine-Waukesha, CFS Area	82.29	0.45	1.14	16.11

Minneapolis-St. Paul-St. Cloud, MN-WI, CFS Area (MN part)	62.32	0.68	2.18	34.82
Pittsburgh-New Castle, CFS Area	78.20	6.05	0.60	15.15
Rochester-Batavia-Seneca Falls, CFS Area	76.10	0.00	0.93	22.97
St. Louis-St. Charles-Farmington, MO-IL, CFS Area (IL part)	36.33	3.66	0.00	60.00
St. Louis-St. Charles-Farmington, MO-IL, CFS Area (MO part)	71.85	3.46	0.00	24.69

Notes: NA indicates missing data.

Table A. 3 Overall inbound freight value of CFS areas in 11 megaregions in 2007

Destination (CFS Areas)	Megaregions	Origins				
		Freight Values from the same CFS Area (million $)	Freight Values from other CFS Areas inside the same Mega (million $)	Freight Values from other CFS Areas in other Megas (million $)	Freight Values from overall US regions(million $)	Percent of freight values delived from CFS Areas inside 11 megas
Phoenix-Mesa-Scottsdale, CFS Area	Arizaona Sun Corridor	49464	2240	45590	238814	40.74
Tucson, CFS Area	Arizaona Sun Corridor	3802	6942	5259	37877	42.25
Portland-Vancouver-Beaverton, OR-WA, CFS Area (OR part)	Cascadia	33627	222	24821	158946	36.91
Seattle-Tacoma-Olympia, CFS Area	Cascadia	60151	723	45655	293881	36.25
Denver-Aurora-Boulder, CFS Area	Front Range	33901	0	22950	167458	33.95
Buffalo-Niagara-Cattaraugus, CFS Area	Great Lake	17658	16365	18704	152124	34.66
Chicago-Naperville-Michigan City, IL-IN-WI, CFS Area (IL part)	Great Lake	155615	67375	61951	795220	35.83
Chicago-Naperville-Michigan City, IL-IN-WI, CFS Area (IN part)	Great Lake	10275	11194	1802	66870	34.80
Cincinnati-Middletown-Wilmington, OH-KY-IN, CFS Area (OH part)	Great Lake	15755	20153	9810	140352	32.57
Cleveland-Akron-Elyria, CFS Area	Great Lake	30432	23801	14843	194944	35.43
Columbus-Marion-Chillicothe, CFS Area	Great Lake	20477	20251	16772	179842	31.97
Dayton-Springfield-Greenville, CFS Area	Great Lake	7629	11948	2818	74172	30.19
Detroit-Warren-Flint, CFS Area	Great Lake	90135	46201	29513	506425	32.75
Grand Rapids-Muskegon-Holland, CFS Area	Great Lake	14438	9905	4936	88237	33.18
Indianapolis-Anderson-Colum	Great Lake	21187	19357	16090	184172	30.75

bus, CFS Area						
Louisville/Jefferson County-Elizabethtown-Scottsburg, KY-IN, CFS Area (KY part)	Great Lake	30755	13863	8938	159705	33.53
Milwaukee-Racine-Waukesha, CFS Area	Great Lake	17721	18501	8321	129651	34.36
Minneapolis-St. Paul-St. Cloud, MN-WI, CFS Area (MN part)	Great Lake	58940	17439	15594	254714	36.11
Pittsburgh-New Castle, CFS Area	Great Lake	33213	8937	14011	157014	35.77
Rochester-Batavia-Seneca Falls, CFS Area	Great Lake	12039	6822	4741	67003	35.23
St. Louis-St. Charles-Farmington, MO-IL, CFS Area (IL part)	Great Lake	7075	6639	1083	47981	30.84
St. Louis-St. Charles-Farmington, MO-IL, CFS Area (MO part)	Great Lake	27785	16175	14910	182326	32.29
Baton Rouge-Pierre Part, CFS Area	Gulf Coast	30329	25028	3551	137000	43.00
Beaumont-Port Arthur, CFS Area	Gulf Coast	38469	2536	1634	100928	42.25
Corpus Christi-Kingsville, CFS Area	Gulf Coast	10755	1393	2565	36895	39.88
Houston-Baytown-Huntsville, CFS Area	Gulf Coast	246820	33722	66067	829980	41.76
Lake Charles-Jennings, CFS Area	Gulf Coast	13681	4055	237	41194	43.63
Mobile-Daphne-Fairhope, CFS Area	Gulf Coast	3096	685	4431	35143	23.37
New Orleans-Metairie-Bogalusa, CFS Area	Gulf Coast	36760	13376	10229	172435	35.01
Sacramento--Arden-Arcade--Yuba City, CA-NV, CFS Area (CA part)	North California	19607	632	20170	118130	34.21
San Jose-San Francisco-Oakland, CFS Area	North California	133274	2480	78283	539892	39.64
Washington-Arlington-Alexandria, DC-VA-MD-WV, CFS Area (DC part)	Northeast	1590	3524	4010	21287	42.86
Washington-Arlington-Alexandria, DC-VA-MD-WV, CFS Area (MD part)	Northeast	5877	3267	21382	80825	37.77
Washington-Baltimore-Northern Virginia, DC-MD-VA-WV, CFS Area (VA part)	Northeast	8408	5808	28315	120481	35.30
Albany-Schenectady-Amsterdam, CFS Area	Northeast	14211	9054	5963	81953	35.66
Baltimore-Towson, CFS Area	Northeast	22022	18134	30456	224249	31.49
Boston-Worcester-Manchester, MA-RI-NH, CFS Area (MA	Northeast	62135	31573	27004	302986	39.84

part)						
Boston-Worcester-Manchester, MA-RI-NH, CFS Area (RI part)	Northeast	5945	11515	1885	48300	40.05
Hartford-West Hartford-Willimantic, CFS Area	Northeast	12712	14629	6180	89115	37.62
New York-Newark-Bridgeport, NY-NJ-CT-PA, CFS Area (CT part)	Northeast	16383	22822	7680	111664	41.99
New York-Newark-Bridgeport, NY-NJ-CT-PA, CFS Area (NJ part)	Northeast	88754	73869	50073	516819	41.15
New York-Newark-Bridgeport, NY-NJ-CT-PA, CFS Area (NY part)	Northeast	115399	98927	54576	644223	41.74
Philadelphia-Camden-Vineland, PA-NJ-DE-MD, CFS Area (NJ part)	Northeast	12809	16951	10774	114144	35.51
Philadelphia-Camden-Vineland, PA-NJ-DE-MD, CFS Area (PA part)	Northeast	33990	36218	26031	269973	35.65
Atlanta-Sandy Springs-Gainesville, GA-AL, CFS Area (GA part)	Piedmont Atlantic	84706	8464	57923	471783	32.03
Birmingham-Hoover-Cullman, CFS Area	Piedmont Atlantic	12977	5169	7811	81488	31.85
Charlotte-Gastonia-Salisbury, NC-SC, CFS Area (NC part)	Piedmont Atlantic	33596	12388	22927	190318	36.21
Greensboro--Winston-Salem--High Point, CFS Area	Piedmont Atlantic	24362	10070	11997	129708	35.80
Greenville-Spartanburg-Anderson, CFS Area	Piedmont Atlantic	10505	6094	10928	88324	31.17
Raleigh-Durham-Cary, CFS Area	Piedmont Atlantic	11763	6549	6350	83482	29.54
Richmond, CFS Area	Piedmont Atlantic	18633	2002	12700	98031	34.00
Las Vegas-Paradise-Pahrump, CFS Area	Southern California	11461	11515	10707	83952	40.12
Los Angeles-Long Beach-Riverside, CFS Area	Southern California	378196	2072	159160	1320486	40.85
San Diego-Carlsbad-San Marcos, CFS Area	Southern California	22295	2371	41256	152066	43.35
Jacksonville, CFS Area	Southern Florida	13273	4635	11528	94546	31.13
Miami-Fort Lauderdale-Pompano Beach, CFS Area	Southern Florida	78885	18717	46877	368343	39.22
Orlando-Deltona-Daytona Beach, CFS Area	Southern Florida	21282	11230	18360	141944	35.84
Tampa-St. Petersburg-Clearwater, CFS Area	Southern Florida	27929	9088	24368	158644	38.69
Austin-Round Rock, CFS Area	Texas Triangle	13274	8201	14299	83397	42.90

Dallas-Fort Worth, CFS Area	Texas Triangle	96610	8684	87318	530214	36.33
San Antonio, CFS Area	Texas Triangle	43332	5960	15891	154853	42.09

Table A. 4 Inbound freight value by mode of CFS areas in 11 megaregions in 2007

CFS Areas	Megaregions	Truck	Rail	Air	Other
Phoenix-Mesa-Scottsdale, CFS Area	Arizaona Sun Corridor	71.74	1.57	0.82	25.86
Tucson, CFS Area	Arizaona Sun Corridor	73.45	0.05	0.43	26.07
Portland-Vancouver-Beaverton, OR-WA, CFS Area (OR part)	Cascadia	64.66	2.95	0.46	31.93
Seattle-Tacoma-Olympia, CFS Area	Cascadia	63.67	1.31	1.51	33.52
Denver-Aurora-Boulder, CFS Area	Front Range	67.92	1.17	0.48	30.42
Buffalo-Niagara-Cattaraugus, CFS Area	Great Lake	78.48	1.11	0.02	20.39
Chicago-Naperville-Michigan City, IL-IN-WI, CFS Area (IL part)	Great Lake	70.34	1.68	1.67	26.31
Chicago-Naperville-Michigan City, IL-IN-WI, CFS Area (IN part)	Great Lake	69.37	4.99	0.02	25.62
Cincinnati-Middletown-Wilmington, OH-KY-IN, CFS Area (OH part)	Great Lake	67.58	5.73	0.34	26.35
Cleveland-Akron-Elyria, CFS Area	Great Lake	78.51	1.35	0.13	20.01
Columbus-Marion-Chillicothe, CFS Area	Great Lake	74.48	0.82	0.07	24.63
Dayton-Springfield-Greenville, CFS Area	Great Lake	84.54	0.03	0.03	15.40
Detroit-Warren-Flint, CFS Area	Great Lake	75.68	3.77	0.09	20.46
Grand Rapids-Muskegon-Holland, CFS Area	Great Lake	83.11	0.38	0.02	16.50
Indianapolis-Anderson-Columbus, CFS Area	Great Lake	77.04	1.16	0.40	21.39
Louisville/Jefferson County-Elizabethtown-Scottsburg, KY-IN, CFS Area (KY part)	Great Lake	62.77	2.24	0.60	34.39
Milwaukee-Racine-Waukesha, CFS Area	Great Lake	76.92	1.33	0.09	21.66
Minneapolis-St. Paul-St. Cloud, MN-WI, CFS Area (MN part)	Great Lake	69.80	1.18	0.29	28.73
Pittsburgh-New Castle, CFS Area	Great Lake	78.26	2.53	0.05	19.15
Rochester-Batavia-Seneca Falls, CFS Area	Great Lake	81.52	0.23	0.12	18.13
St. Louis-St. Charles-Farmington, MO-IL, CFS Area (IL part)	Great Lake	64.40	2.05	0.00	33.54
St. Louis-St. Charles-Farmington, MO-IL, CFS Area (MO part)	Great Lake	72.06	0.53	0.02	27.39
Baton Rouge-Pierre Part, CFS Area	Gulf Coast	29.74	3.47	0.01	66.78
Beaumont-Port Arthur, CFS Area	Gulf Coast	27.05	7.64	0.00	65.31
Corpus Christi-Kingsville, CFS Area	Gulf Coast	52.78	1.01	0.03	46.18
Houston-Baytown-Huntsville, CFS Area	Gulf Coast	45.44	6.67	0.23	47.67
Lake Charles-Jennings, CFS Area	Gulf Coast	39.66	7.05	0.00	53.29
Mobile-Daphne-Fairhope, CFS Area	Gulf Coast	66.44	5.90	0.01	27.65
New Orleans-Metairie-Bogalusa, CFS Area	Gulf Coast	32.96	1.53	0.07	65.44
Sacramento--Arden-Arcade--Yuba City, CA-NV, CFS Area (CA part)	North California	75.76	0.19	0.06	23.98
San Jose-San Francisco-Oakland, CFS Area	North California	59.72	1.13	5.79	33.35
Albany-Schenectady-Amsterdam, CFS Area	Northeast	71.22	1.96	0.07	26.74
Baltimore-Towson, CFS Area	Northeast	76.66	4.89	0.32	18.13

Boston-Worcester-Manchester, MA-RI-NH, CFS Area (MA part)	Northeast	75.10	0.37	1.03	23.50
Boston-Worcester-Manchester, MA-RI-NH, CFS Area (RI part)	Northeast	76.34	0.04	0.22	23.40
Hartford-West Hartford-Willimantic, CFS Area	Northeast	78.45	0.04	0.83	20.68
New York-Newark-Bridgeport, NY-NJ-CT-PA, CFS Area (CT part)	Northeast	76.30	0.11	0.18	23.41
New York-Newark-Bridgeport, NY-NJ-CT-PA, CFS Area (NJ part)	Northeast	68.01	1.14	0.87	29.98
New York-Newark-Bridgeport, NY-NJ-CT-PA, CFS Area (NY part)	Northeast	65.98	0.03	3.71	30.28
Philadelphia-Camden-Vineland, PA-NJ-DE-MD, CFS Area (NJ part)	Northeast	68.57	2.87	0.10	28.45
Philadelphia-Camden-Vineland, PA-NJ-DE-MD, CFS Area (PA part)	Northeast	74.22	0.90	0.17	24.71
Washington-Arlington-Alexandria, DC-VA-MD-WV, CFS Area (DC part)	Northeast	60.49	0.00	0.02	39.49
Washington-Arlington-Alexandria, DC-VA-MD-WV, CFS Area (MD part)	Northeast	71.96	0.01	0.08	27.94
Washington-Baltimore-Northern Virginia, DC-MD-VA-WV, CFS Area (VA part)	Northeast	68.81	0.48	0.71	30.00
Atlanta-Sandy Springs-Gainesville, GA-AL, CFS Area (GA part)	Piedmont Atlantic	79.29	1.17	0.32	19.22
Birmingham-Hoover-Cullman, CFS Area	Piedmont Atlantic	69.45	4.34	0.02	26.19
Charlotte-Gastonia-Salisbury, NC-SC, CFS Area (NC part)	Piedmont Atlantic	83.83	1.61	0.07	14.49
Greensboro--Winston-Salem--High Point, CFS Area	Piedmont Atlantic	79.77	1.79	0.02	18.42
Greenville-Spartanburg-Anderson, CFS Area	Piedmont Atlantic	73.25	4.14	0.10	22.51
Raleigh-Durham-Cary, CFS Area	Piedmont Atlantic	77.71	1.04	0.06	21.20
Richmond, CFS Area	Piedmont Atlantic	78.95	2.24	0.18	18.64
Las Vegas-Paradise-Pahrump, CFS Area	Southern California	69.87	0.34	0.35	29.44
Los Angeles-Long Beach-Riverside, CFS Area	Southern California	65.53	1.44	1.94	31.08
San Diego-Carlsbad-San Marcos, CFS Area	Southern California	68.16	0.06	0.36	31.42
Jacksonville, CFS Area	Southern Florida	70.08	10.79	0.05	19.08
Miami-Fort Lauderdale-Pompano Beach, CFS Area	Southern Florida	69.83	0.35	2.16	27.66
Orlando-Deltona-Daytona Beach, CFS Area	Southern Florida	79.47	0.13	0.18	20.22
Tampa-St. Petersburg-Clearwater, CFS Area	Southern Florida	68.84	1.63	0.22	29.31
Austin-Round Rock, CFS Area	Texas Triangle	72.81	0.04	0.42	26.73
Dallas-Fort Worth, CFS Area	Texas Triangle	71.60	1.05	1.07	26.29
San Antonio, CFS Area	Texas Triangle	61.54	0.19	0.14	38.13

Table A. 5 Overall outbound freight characteristics of CBSAs in 2002

Origin CBSAs	Megaregions	Value	Tons	Ton-miles
Phoenix–Mesa–Scottsdale, AZ MSA	Arizaona Sun Corridor	89,683	64,085	8,835
Tucson, AZ MSA	Arizaona Sun Corridor	11,084	7,650	1,198
Portland–Vancouver–Beaverton, OR–WA MSA (OR Part)	Cascadia	69,685	83,962	14,313

Denver–Aurora–Boulder, CO CSA	Front Range	62,628	69,744	25,151
Buffalo–Cheektowaga–Tonawanda, NY MSA	Great Lake	30,338	29,173	5,388
Chicago–Naperville–Michigan City, IL–IN–WI CSA (IL Part)	Great Lake	304,602	398,993	77,885
Chicago–Naperville–Michigan City, IL–IN–WI CSA (IN Part)	Great Lake	26,236	101,090	22,619
Cincinnati–Middletown–Wilmington, OH–KY–IN CSA (OH Part)	Great Lake	64,980	64,110	19,888
Cleveland–Akron–Elyria, OH CSA	Great Lake	103,926	94,506	22,674
Columbus–Marion–Chillicothe, OH CSA	Great Lake	109,846	70,674	13,676
Dayton–Springfield–Greenville, OH CSA	Great Lake	26,964	34,780	3,897
Detroit–Warren–Flint, MI CSA	Great Lake	219,616	155,808	23,758
Grand Rapids–Wyoming–Holland, MI CSA	Great Lake	68,649	42,116	9,379
Indianapolis–Anderson–Columbus, IN CSA	Great Lake	73,522	58,586	11,876
Louisville–Elizabethtown–Scottsburg, KY–IN CSA (KY Part)	Great Lake	44,955	34,856	5,868
Milwaukee–Racine–Waukesha, WI CSA	Great Lake	64,826	54,678	13,223
Minneapolis–St Paul–St Cloud, MN–WI CSA (MN Part)	Great Lake	118,297	171,270	52,836
Pittsburgh–New Castle, PA CSA	Great Lake	57,050	94,275	34,697
Rochester–Batavia–Seneca Falls, NY CSA	Great Lake	33,506	30,204	5,875
St Louis, MO–IL MeSA (IL Part)	Great Lake	15,992	69,698	13,745
St Louis–St Charles–Farmington, MO–IL CSA (MO Part)	Great Lake	62,423	84,178	19,244
Houston–Baytown–Huntsville, TX CSA	Gulf Coast	196,694	461,798	76,355
New Orleans–Metairie–Bogalusa, LA CSA	Gulf Coast	58,169	250,023	39,839
Sacramento—Arden–Arcade—Truckee, CA–NV CSA (CA Part)	North California	38,298	59,582	14,277
San Jose–San Francisco–Oakland, CA CSA	North California	197,541	152,746	28,148
Seattle–Tacoma–Olympia, WA CSA	North California	129,135	59,977	13,905
Albany–Schenectady–Amsterdam, NY CSA	Northeast	26,161	20,293	3,204
Baltimore–Towson, MD MeSA	Northeast	70,963	105,639	10,383
Boston–Worcester–Manchester, MA–NH CSA (MA Part)	Northeast	126,364	55,227	10,584
New York–Newark–Bridgeport, NY–NJ–CT–PA CSA (CT Part)	Northeast	42,815	24,383	2,817

New York–Newark–Bridgeport, NY–NJ–CT–PA CSA (NJ Part)	Northeast	224,325	158,066	32,467
New York–Newark–Bridgeport, NY–NJ–CT–PA CSA (NY Part)	Northeast	168,488	101,563	26,954
Philadelphia–Camden–Vineland, PA–NJ–DE–MD CSA (NJ Part)	Northeast	57,965	69,456	8,406
Philadelphia–Camden–Vineland, PA–NJ–DE–MD CSA (PA Part)	Northeast	118,942	86,596	10,021
Washington–Arlington–Alexandria, DC–VA–MD–WV MeSA (DC Part)	Northeast	3,707	1,407	34
Washington–Arlington–Alexandria, DC–VA–MD–WV MeSA (MD Part)	Northeast	36,708	32,073	2,075
Washington–Baltimore–Northern Virginia, DC–MD–VA–WV CSA (VA Part)	Northeast	23,269	50,235	3,419
Atlanta–Sandy Springs–Gainesville, GA–AL CSA (GA Part)	Piedmont Atlantic	158,772	202,099	27,909
Birmingham–Hoover–Cullman, AL CSA	Piedmont Atlantic	33,462	63,492	16,073
Charlotte–Gastonia–Salisbury, NC–SC CSA (NC Part)	Piedmont Atlantic	90,039	62,832	11,412
Greensboro—Winston–Salem—High Point, NC CSA	Piedmont Atlantic	60,096	45,110	7,135
Greenville–Anderson–Seneca, SC CSA	Piedmont Atlantic	44,555	21,947	3,906
Raleigh–Durham–Cary, NC CSA	Piedmont Atlantic	43,541	33,056	4,164
Richmond, VA MeSA	Piedmont Atlantic	55,000	57,025	8,794
Las Vegas–Paradise–Pahrump, NV CSA	Southern California	15,210	25,507	4,715
Los Angeles–Long Beach–Riverside, CA CSA	Southern California	504,949	384,278	74,054
San Diego–Carlsbad–San Marcos, CA MeSA	Southern California	58,843	60,746	3,252
Jacksonville, FL MeSA	Southern Florida	46,433	34,590	5,938
Miami–Fort Lauderdale–Miami Beach, FL MeSA	Southern Florida	83,857	77,100	11,774
Orlando–The Villages, FL CSA	Southern Florida	47,102	21,439	2,857
Tampa–St Petersburg–Clearwater, FL MeSA	Southern Florida	49,632	58,927	8,791
Austin–Round Rock, TX MeSA	Texas Triangle	19,915	17,207	1,302
Dallas–Fort Worth, TX CSA	Texas Triangle	179,821	136,759	40,049
San Antonio, TX MeSA	Texas Triangle	32,918	48,981	6,912

Table A. 6 Overall inbound freight characteristics of CBSAs in 2002

Destination CBSAs	Megaregions	Value	Tons	Ton-miles
Phoenix–Mesa–Scottsdale, AZ MeSA	Arizaona Sun Corridor	81,866	71,332	25,437
Tucson, AZ MeSA	Arizaona Sun Corridor	16,169	10,896	3,890
Portland–Vancouver–Beaverton, OR–WA MeSA (OR Part)	Cascadia	57,663	111,102	30,261
Denver–Aurora–Boulder, CO CSA	Front Range	67,171	69,683	20,915
Buffalo–Cheektowaga–Tonawanda, NY MeSA	Great Lake	46,537	45,087	11,822
Chicago–Naperville–Michigan City, IL–IN–WI CSA (IL Part)	Great Lake	282,374	384,554	82,383
Chicago–Naperville–Michigan City, IL–IN–WI CSA (IN Part)	Great Lake	28,022	137,255	38,140
Cincinnati–Middletown–Wilmington, OH–KY–IN CSA (OH Part)	Great Lake	58,495	86,239	21,050
Cleveland–Akron–Elyria, OH CSA	Great Lake	86,695	125,774	38,708
Columbus–Marion–Chillicothe, OH CSA	Great Lake	88,453	82,534	23,114
Dayton–Springfield–Greenville, OH CSA	Great Lake	43,282	46,625	6,809
Detroit–Warren–Flint, MI CSA	Great Lake	279,672	211,067	59,208
Grand Rapids–Wyoming–Holland, MI CSA	Great Lake	40,067	48,701	9,562
Indianapolis–Anderson–Columbus, IN CSA	Great Lake	69,871	70,696	11,666
Louisville–Elizabethtown–Scottsburg, KY–IN CSA (KY Part)	Great Lake	61,790	76,185	21,346
Milwaukee–Racine–Waukesha, WI CSA	Great Lake	51,885	55,676	15,465
Minneapolis–St Paul–St Cloud, MN–WI CSA (MN Part)	Great Lake	114,852	176,760	39,214
Pittsburgh–New Castle, PA CSA	Great Lake	54,792	86,618	18,890
Rochester–Batavia–Seneca Falls, NY CSA	Great Lake	22,552	29,151	5,428
St Louis, MO–IL MeSA (IL Part)	Great Lake	16,773	54,499	11,618
St Louis–St Charles–Farmington, MO–IL CSA (MO Part)	Great Lake	68,842	84,849	26,304
Houston–Baytown–Huntsville, TX CSA	Gulf Coast	199,034	462,689	87,003
New Orleans–Metairie–Bogalusa, LA CSA	Gulf Coast	65,860	302,747	131,878
Sacramento—Arden–Arcade—Truckee, CA–NV CSA (CA Part)	North California	43,808	87,960	12,776
San Jose–San Francisco–Oakland, CA CSA	North California	207,916	174,664	53,165

Seattle–Tacoma–Olympia, WA CSA	North California	172,276	94,396	35,897
Albany–Schenectady–Amsterdam, NY CSA	Northeast	28,391	23,394	9,433
Baltimore–Towson, MD MeSA	Northeast	90,630	116,257	21,172
Boston–Worcester–Manchester, MA–NH CSA (MA Part)	Northeast	120,883	68,812	16,627
New York–Newark–Bridgeport, NY–NJ–CT–PA CSA (CT Part)	Northeast	37,223	28,441	5,471
New York–Newark–Bridgeport, NY–NJ–CT–PA CSA (NJ Part)	Northeast	212,086	196,467	73,253
New York–Newark–Bridgeport, NY–NJ–CT–PA CSA (NY Part)	Northeast	202,269	114,530	34,813
Philadelphia–Camden–Vineland, PA–NJ–DE–MD CSA (NJ Part)	Northeast	45,702	56,619	9,997
Philadelphia–Camden–Vineland, PA–NJ–DE–MD CSA (PA Part)	Northeast	100,056	105,103	19,327
Washington–Arlington–Alexandria, DC–VA–MD–WV MeSA (DC Part)	Northeast	14,154	6,432	749
Washington–Arlington–Alexandria, DC–VA–MD–WV MeSA (MD Part)	Northeast	43,769	42,587	7,284
Washington–Baltimore–Northern Virginia, DC–MD–VA–WV CSA (VA Part)	Northeast	52,096	68,413	10,019
Atlanta–Sandy Springs–Gainesville, GA–AL CSA (GA Part)	Piedmont Atlantic	184,361	226,936	54,337
Birmingham–Hoover–Cullman, AL CSA	Piedmont Atlantic	33,289	77,821	37,661
Charlotte–Gastonia–Salisbury, NC–SC CSA (NC Part)	Piedmont Atlantic	69,715	78,536	18,420
Greensboro—Winston–Salem—High Point, NC CSA	Piedmont Atlantic	55,449	54,784	8,749
Greenville–Anderson–Seneca, SC CSA	Piedmont Atlantic	30,879	24,169	4,274
Raleigh–Durham–Cary, NC CSA	Piedmont Atlantic	40,313	51,066	9,339
Richmond, VA MeSA	Piedmont Atlantic	47,995	54,247	10,135
Las Vegas–Paradise–Pahrump, NV CSA	Southern California	32,037	36,552	9,418
Los Angeles–Long Beach–Riverside, CA CSA	Southern California	453,493	387,629	126,358
San Diego–Carlsbad–San Marcos, CA MeSA	Southern California	61,318	72,508	9,265
Jacksonville, FL MeSA	Southern Florida	38,074	57,940	12,587
Miami–Fort Lauderdale–Miami Beach, FL MeSA	Southern Florida	133,080	93,949	30,185
Orlando–The Villages, FL CSA	Southern Florida	49,748	34,425	11,182
Tampa–St Petersburg–Clearwater, FL MeSA	Southern Florida	68,610	115,048	36,473
Austin–Round Rock, TX MeSA	Texas Triangle	30,133	29,113	NA

Dallas–Fort Worth, TX CSA	Texas Triangle	181,903	147,401	52,348
San Antonio, TX MeSA	Texas Triangle	42,609	52,959	NA

References

Bureau of Economic Analysis (BEA), (2012). *Local Area Personal Income, 2009 – 2011.* http://www.bea.gov/newsreleases/regional/lapi/lapi_newsrelease.htm.

Carbonell, Armando, & Yaro, Robert. (2005). American Spatial Development and the New Megalopolis. *Land Lines* 17(2).

Dewar, M., & Epstein, D. (2007). Planning for "Megaregions" in the United States. *Journal of Planning Literature, 22*(4), 108-124.

Florida, R., Gulden, T., & Mellander, C. (2008). The rise of the mega-region. Cambridge *Journal of Regions, Economy and Society*, 1(3), 459-476.

Goldman Sachs Group, Inc, (2007), *The N-11: More Than an Acronym*, Global Economics Paper No: 153, 28.

Lang, R. E., & Dhavale, D. (2005). *Beyond megalopolis: exploring America's new "Megapolitan" geography*. Alexandra, VA: Metropolitan Institute at Virginia Tech.

National Household Travel Survey (NHTS), 2001, 2009, http://nhts.ornl.gov/

Regional Plan Association. (2006). *America 2050: A Prospectus.* New York.

Regional Plan Association. (2009). *Defining U.S. Megaregions,* http://www.america2050.org/upload/2010/09/2050_Defining_US_Megaregions.pdf

Schafer, A., 1998. The global demand for motorized mobility. *Transportation Research A* 32 (6), pp. 455-477.

Schafer, A., & Victor, D. G. (2000). The future mobility of the world population. *Transportation Research Part A*, 34(3), 171-205.

TSDC (Texas State Data Center) (2012). *Texas 2012 Population Projections.* Accessed December 25, 2008 at URL: http://txsdc.utsa.edu/tpepp/2012projections/

Zahavi, Y., & Talvitie, A. (1980). Regularities in travel time and money expenditures. *Transportation Research Record,* 750, 13-19.

Zhang, M., & Chen, B. (2009). *Future Travel Demand and Its Implications for Transportation Infrastructure Investments in the Texas Triangle* (No. SWUTC/09/167276-1). Center for Transportation Research, University of Texas at Austin.