“Essentially, all models are wrong, but some are useful…the practical question is how wrong do they have to be to not be useful.”

-- George Box

Validation of CMAP's Travel Demand Model

Craig Heither, CMAP

Presented to Chicago Area Travel Model Users Group

June 1, 2011

Chicago Metropolitan Agency for Planning

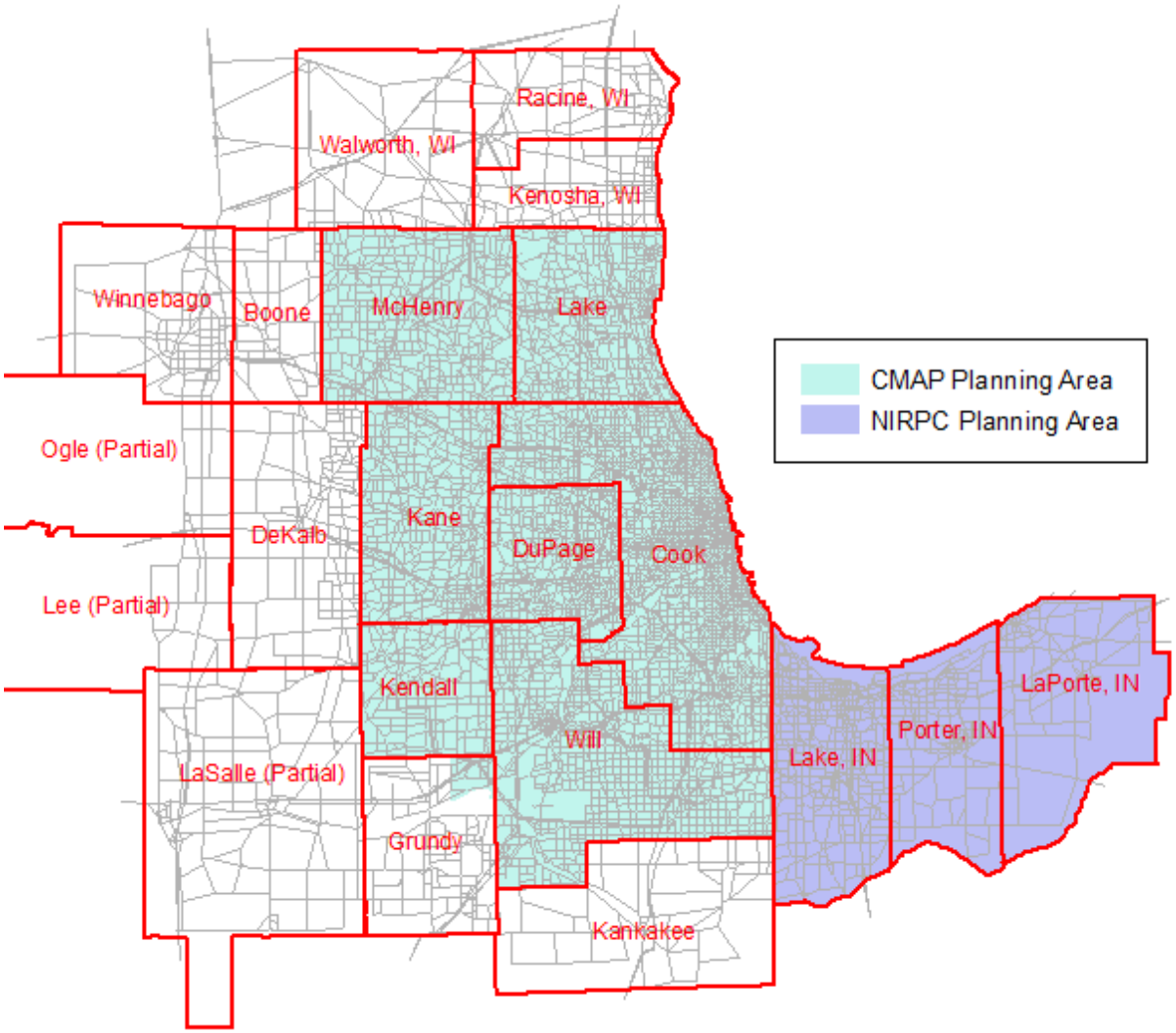
Travel Demand Model Validation

- Determining the reasonableness of model results.

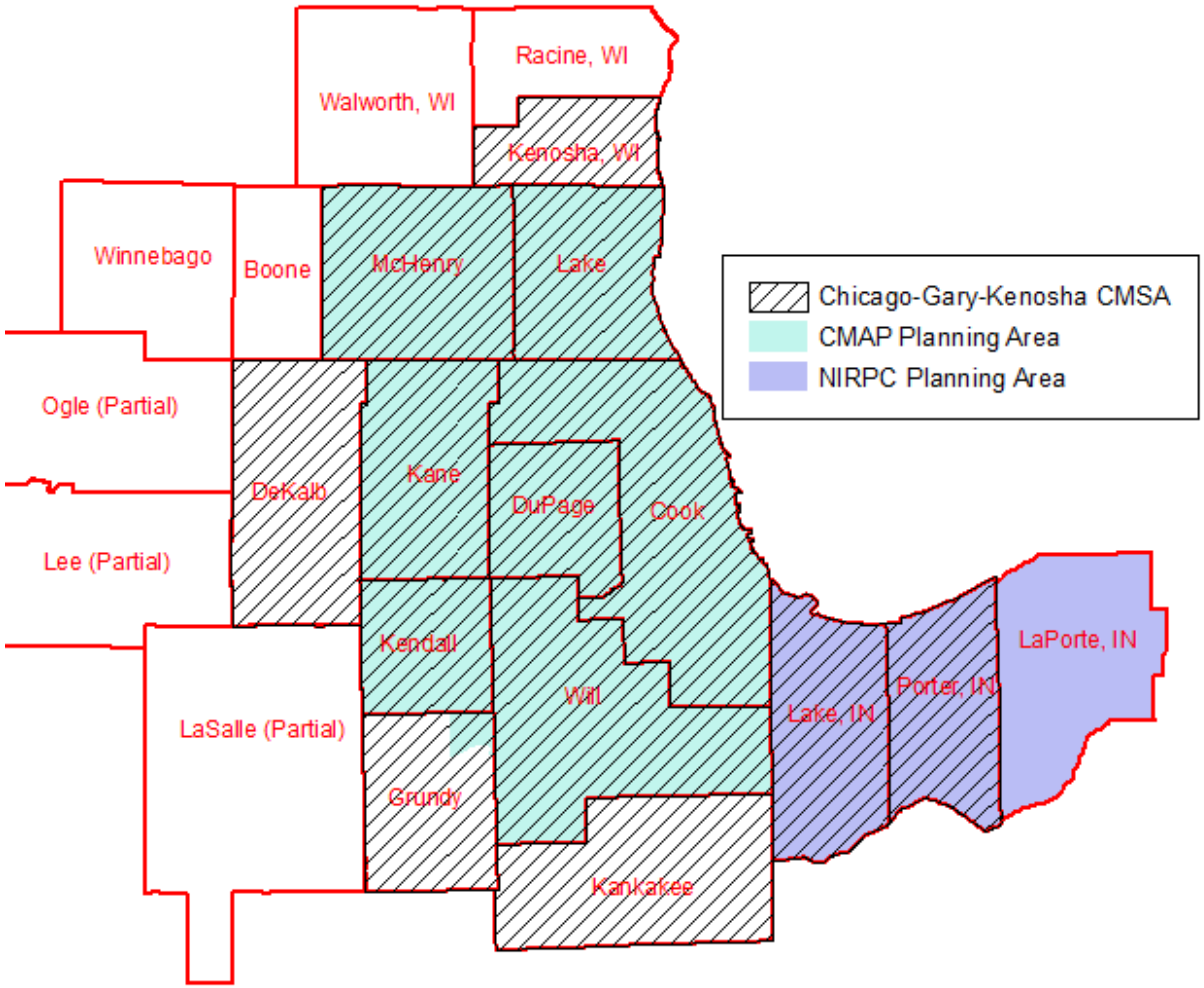
- Two important concepts:
  1. Independent data whenever possible.

  2. Reasonable ≠ Exact.

Modeling Area



2009 National Household Travel Survey



Share of Households by Adults & Children

	0 children		1 child		2+ children	
	Observed	*Model*	*Observed*	*Model*	*Observed*	*Model*
1 adult	27.4%	26.9%	0.9%	2.2%	0.8%	3.1%
2 adults	26.5%	25.0%	8.4%	7.0%	15.4%	16.9%
3+ adults	12.0%	9.0%	4.5%	4.0%	3.9%	5.8%

NHTS data: adults redefined as 16+.

Share of Households by Workers & Vehicles

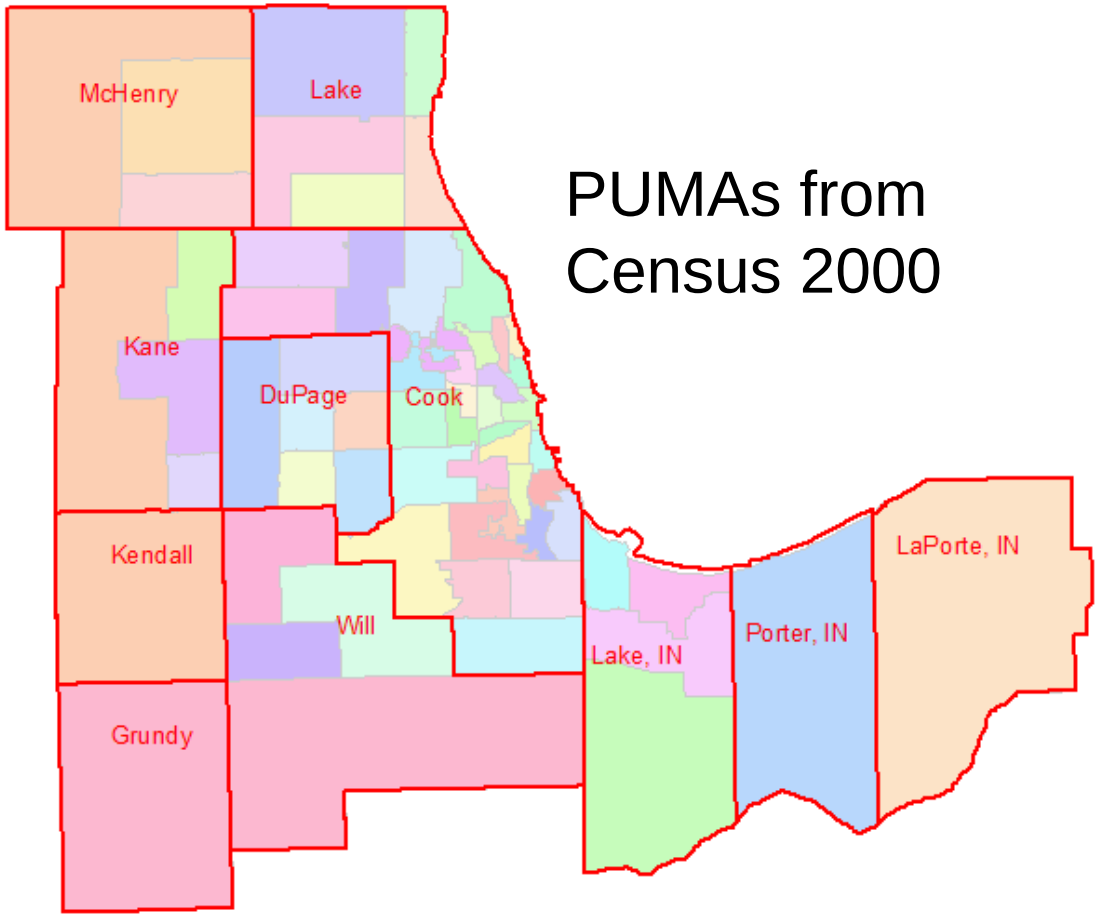
	0 vehicles		1 vehicle		2 vehicles		3+ vehicles	
	Observed	*Model*	*Observed*	*Model*	*Observed*	*Model*	*Observed*	*Model*
0 workers	8.0%	6.6%	11.9%	11.2%	5.0%	3.8%	1.1%	0.7%
1+ workers	5.0%	5.9%	22.4%	23.8%	29.9%	33.6%	16.8%	14.3%

Household Trip Generation Rates

	CMAP Model	2009 NHTS	Other MPOs
Home-Based Work	1.64	1.18 STDV: 1.96	
Home-Based Other	2.95	2.39 STDV: 3.96	
Non-Home Based	1.60	1.20 STDV: 2.30	

NHTS data: redefined trip purposes.

Trip Length Summary Areas



PUMAs from
Census 2000

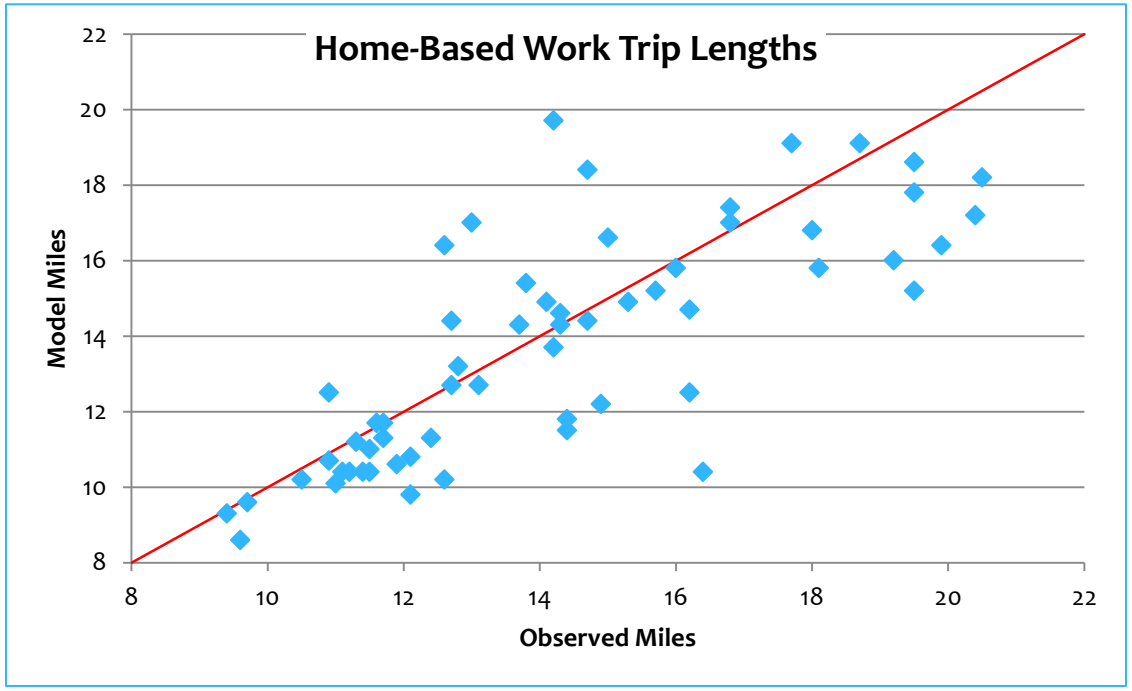
Trip Length Results

Average Trip Distance (Miles)

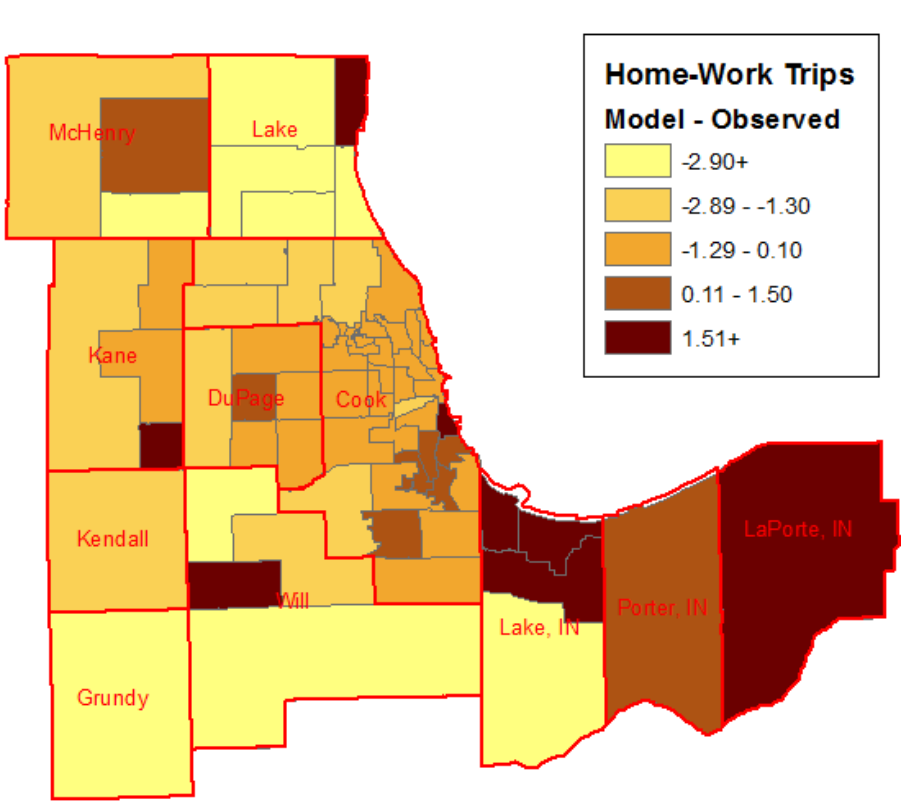
	HBW	HBO	NHB
Observed	14.3	6.4	6.8
Modeled	13.8	6.5	7.1

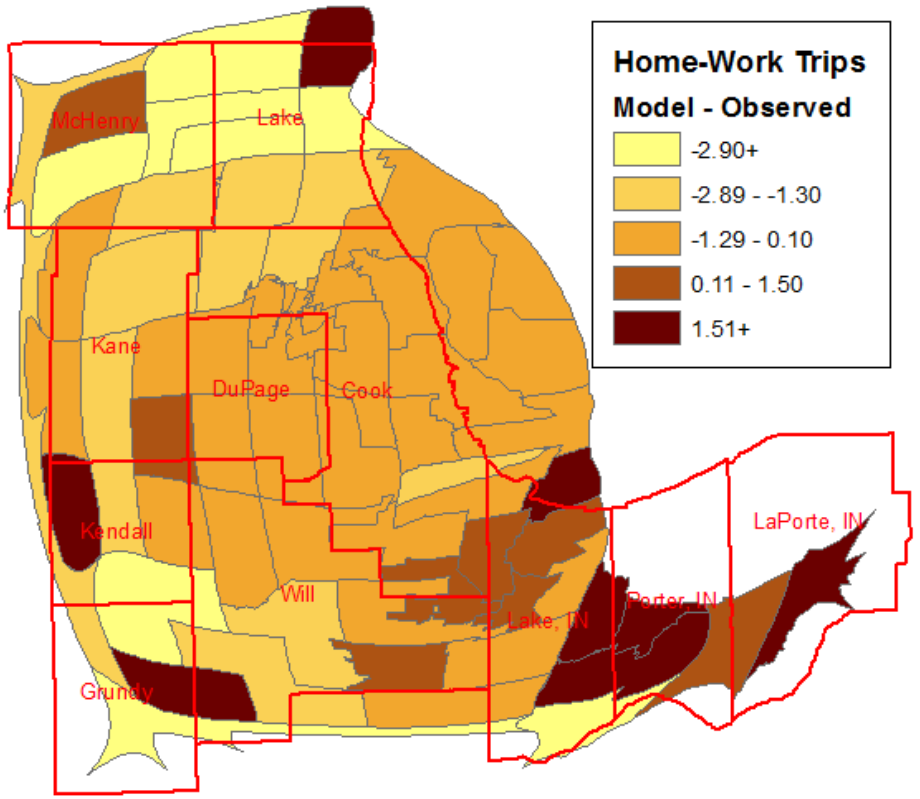
Source: 2000 CTPP (HBW) &Travel Tracker (HBO/NHB)

Average Trip Distance (Miles)

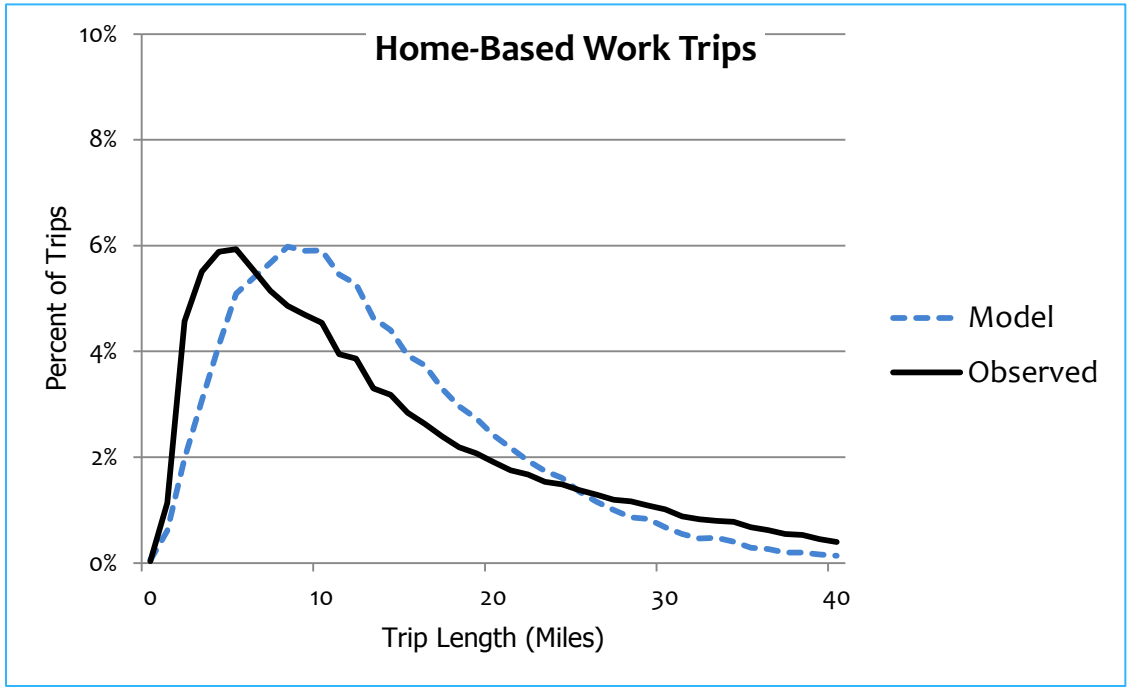


Home-Based Work Trips

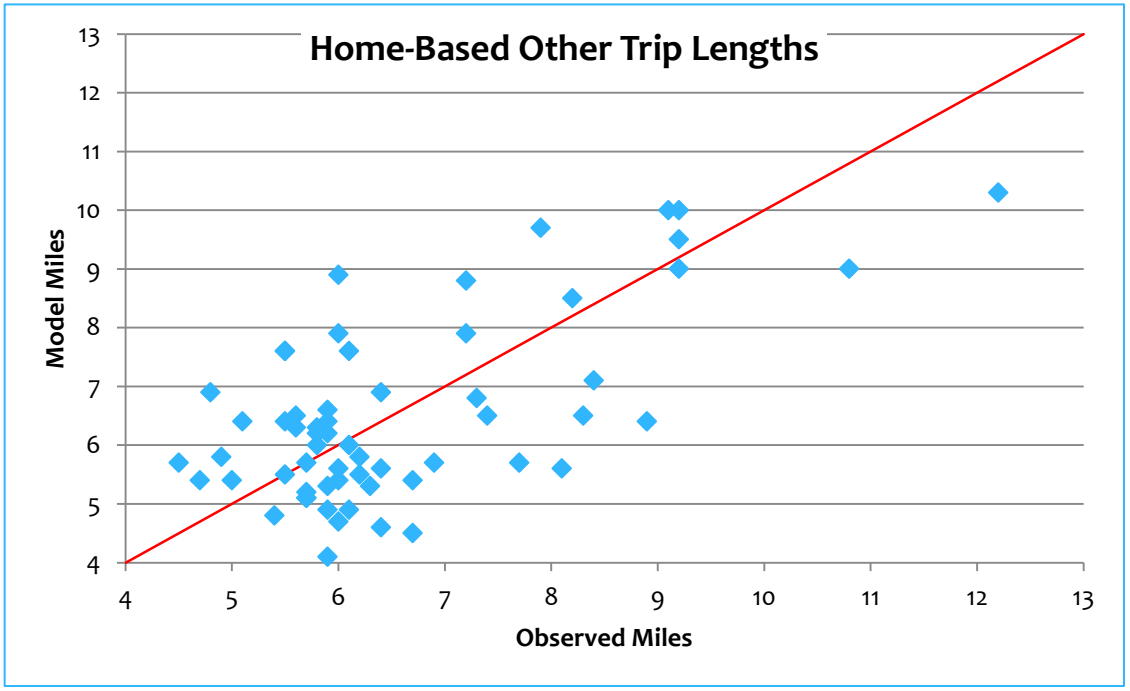




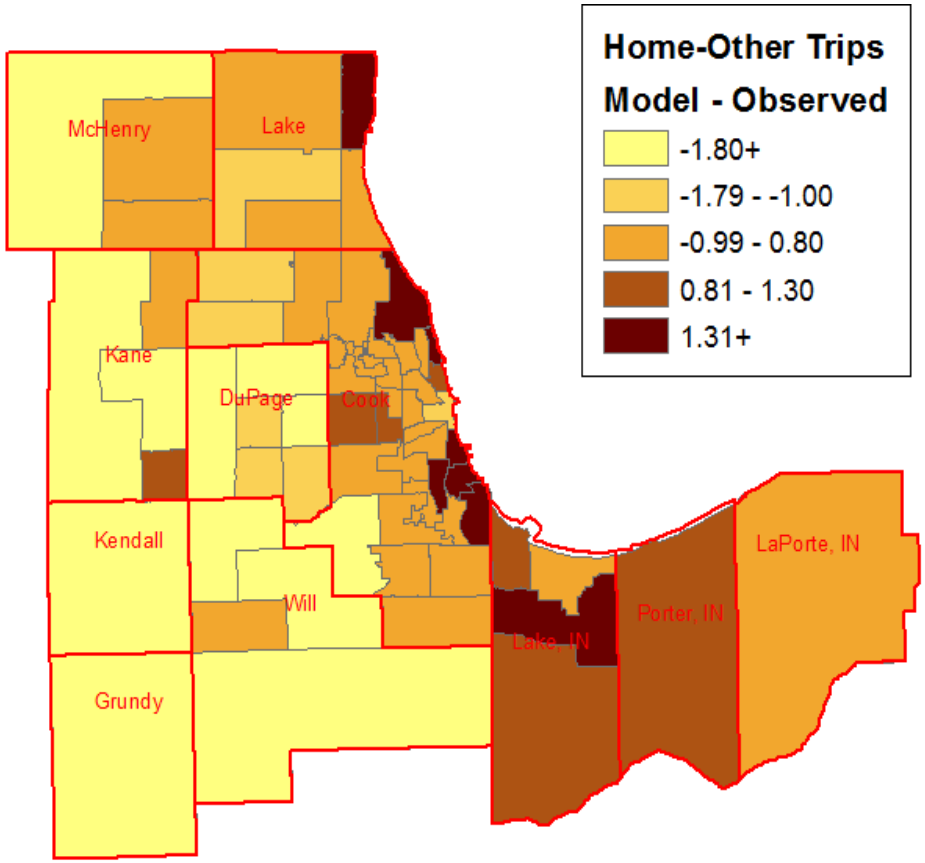
Trip Length Frequency Distribution

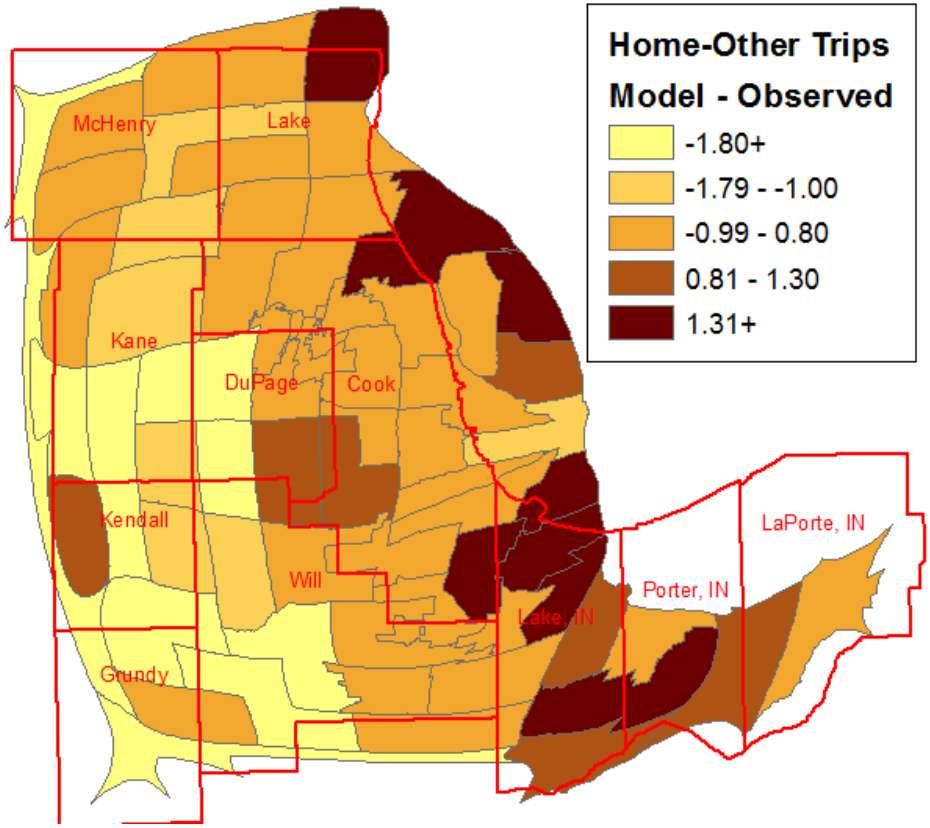


Average Trip Distance (Miles)

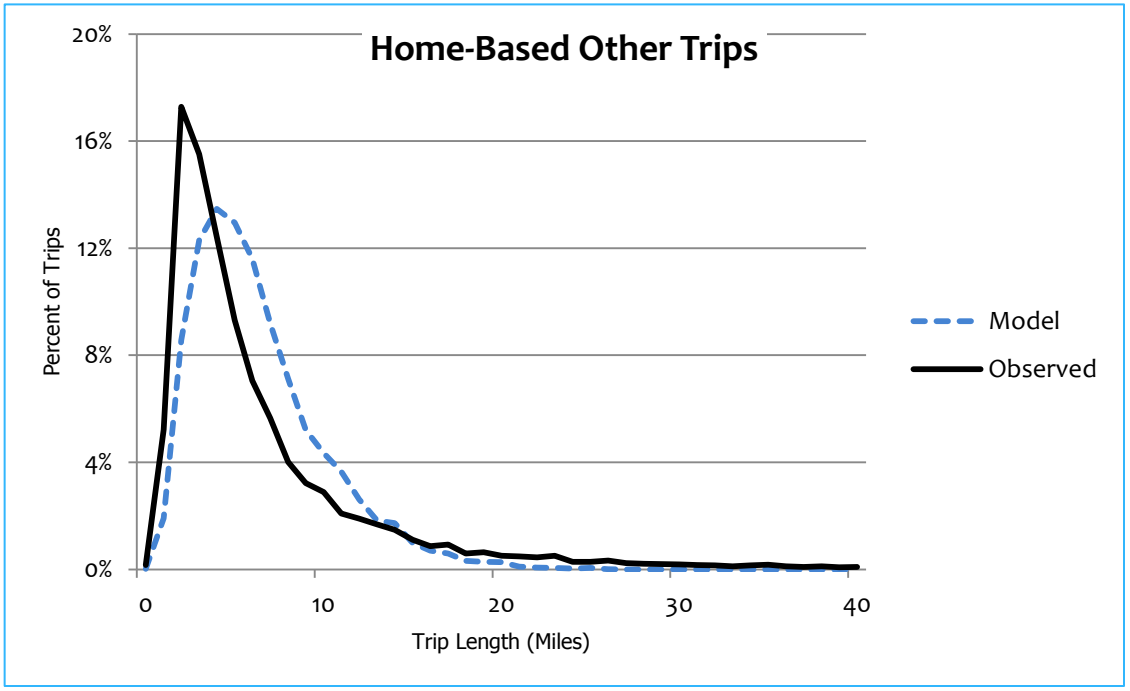


Home-Based Other Trips

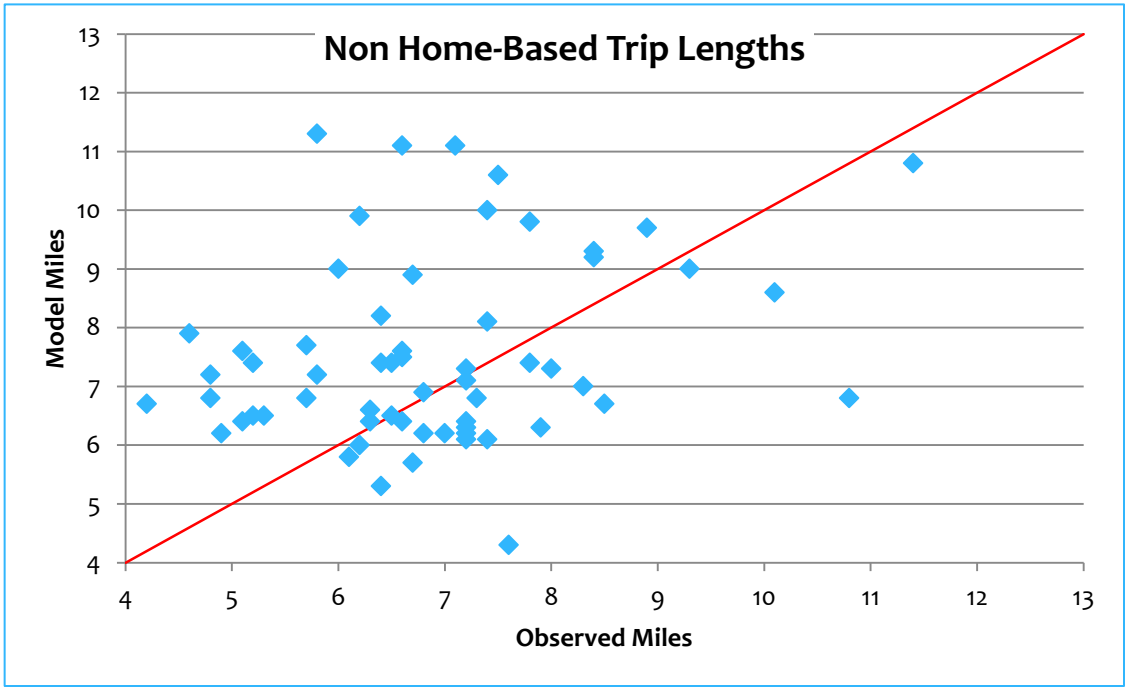




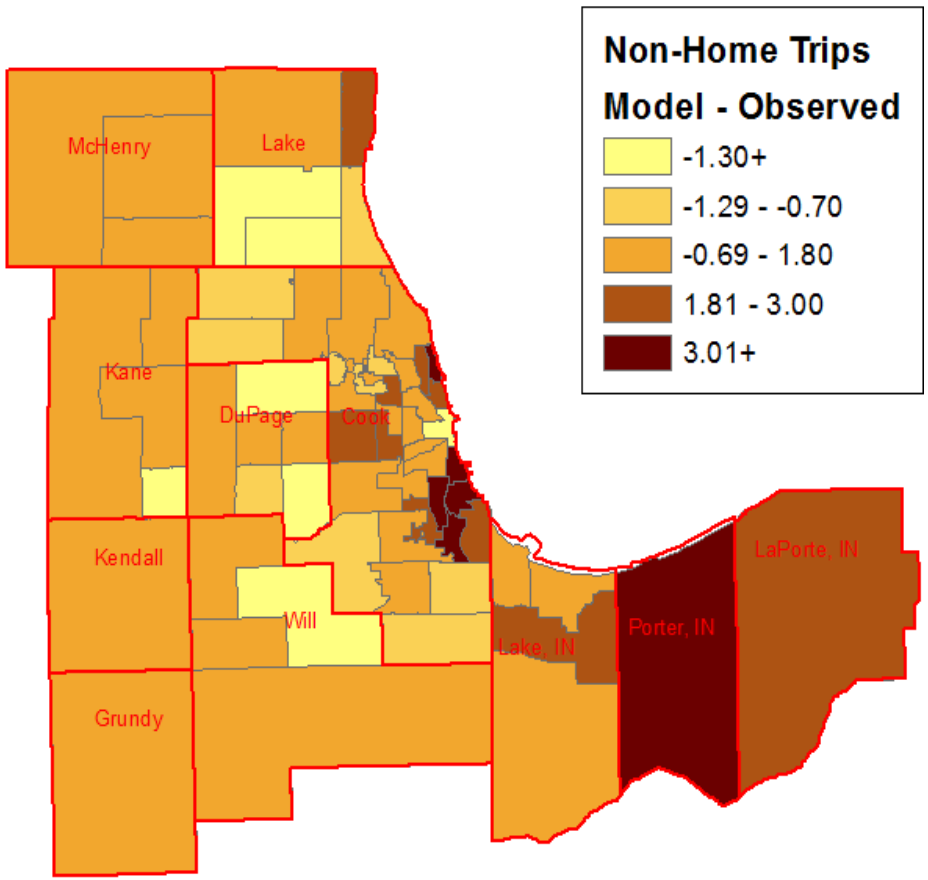
Trip Length Frequency Distribution

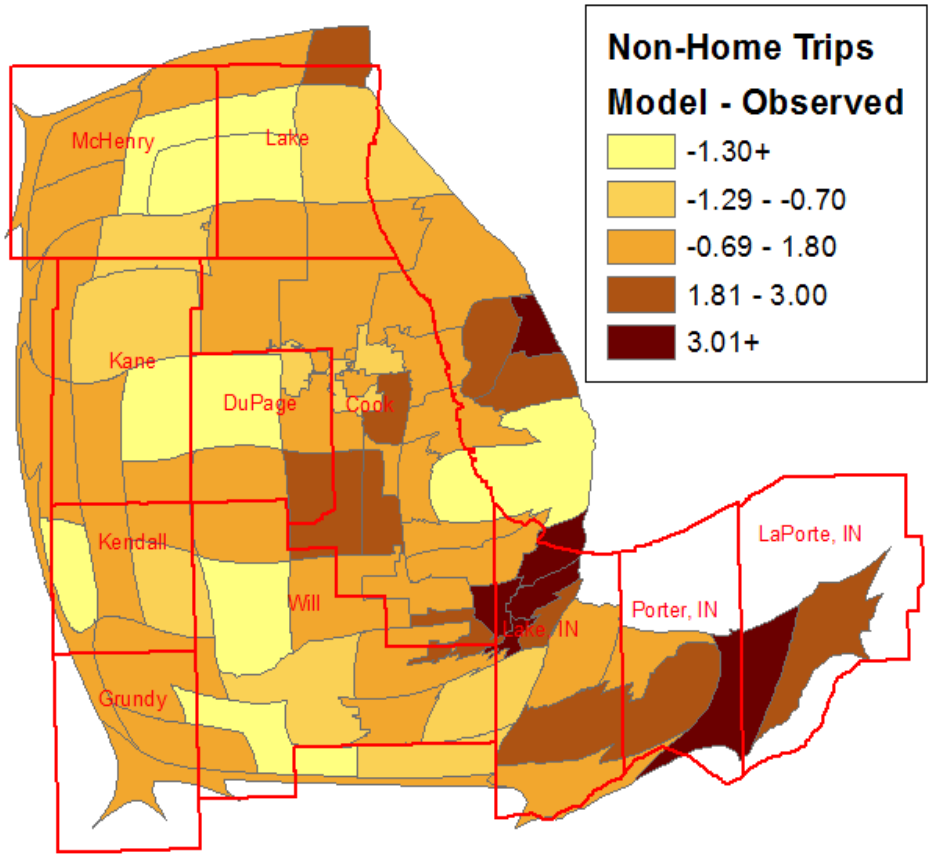


Average Trip Distance (Miles)

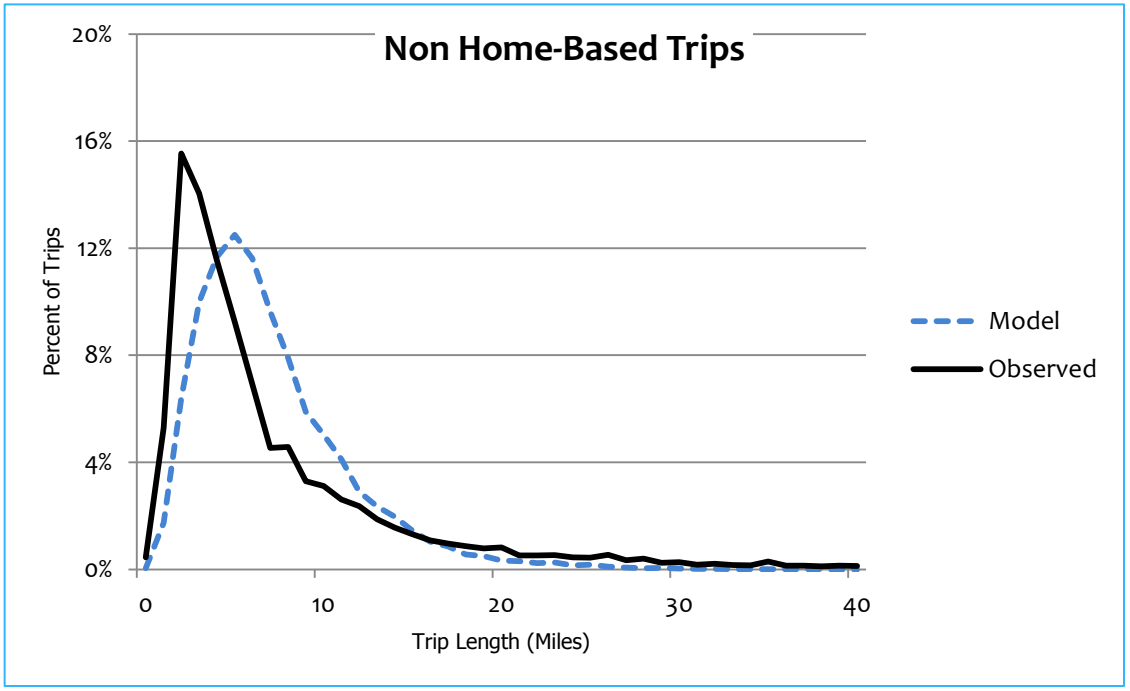


Non-Home Based Trips





Trip Length Frequency Distribution



County-to-County Work Trip Flows

Residence \ Work Place	Cook	DuPage	Grundy	Kane	Kendall	Lake	McHenry	Will	Lake IN	LaPorte	Porter	TOTAL
Cook	1.01	0.72		0.36		0.75	0.35	0.61	3.10			*0.96*
DuPage	0.96	1.17		1.05	1.08			0.92				*1.03*
Grundy			0.91					1.39				*0.69*
Kane	0.82	1.62		1.01	1.53	0.39	1.82	0.94				*1.09*
Kendall		0.92		1.92	1.22			2.63				*1.09*
Lake	0.64					1.37	1.72					*1.01*
McHenry	0.61			1.56		1.75	1.05					*0.96*
Will	0.85	1.35	1.78	0.99	2.99			1.29	3.84			*1.11*
Lake IN	1.49							1.03	0.92	1.71	1.55	*1.07*
LaPorte									1.53	1.04	2.11	*1.20*
Porter	0.94								1.04	3.32	0.85	*1.08*
TOTAL	*0.97*	*1.00*	*1.09*	*0.94*	*1.30*	*1.09*	*1.03*	*1.08*	*1.13*	*1.37*	*1.13*	*1.00*

Transit Mode Share by Purpose

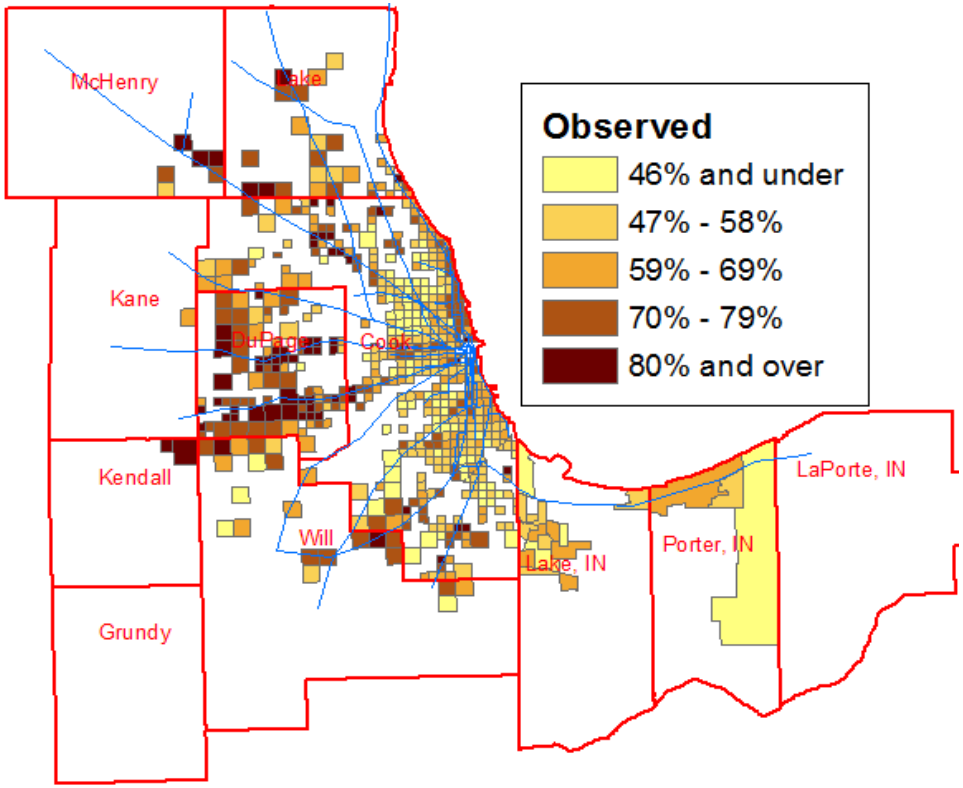
	Observed	Model	Percentage Point Difference
Home-Based Work	11.9%	12.2%	0.3
Home-Based Other	5.5%	4.9%	-0.6
Non-Home Based	4.1%	3.1%	-1.0
OVERALL	6.8%	6.4%	-0.4

Source: 2000 CTPP (HBW) &Travel Tracker (HBO/NHB)

Home-Based Work Trip Mode Share

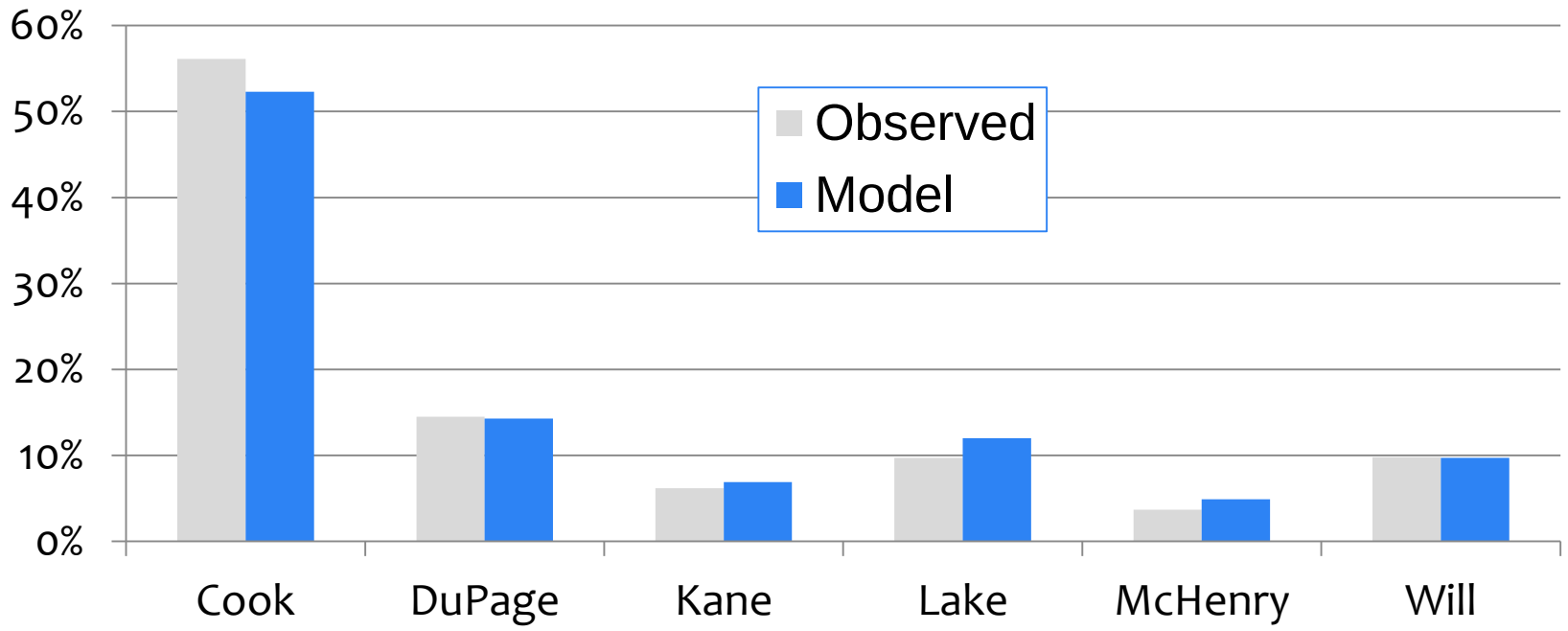
	Observed	Model	Percentage Point Difference
Entire Region			
Auto: Drive Alone	76.4%	75.0%	-1.4
Auto: Shared Ride	11.7%	12.8%	1.1
Transit	11.9%	12.2%	0.3

Transit Share of Work Trips to CBD



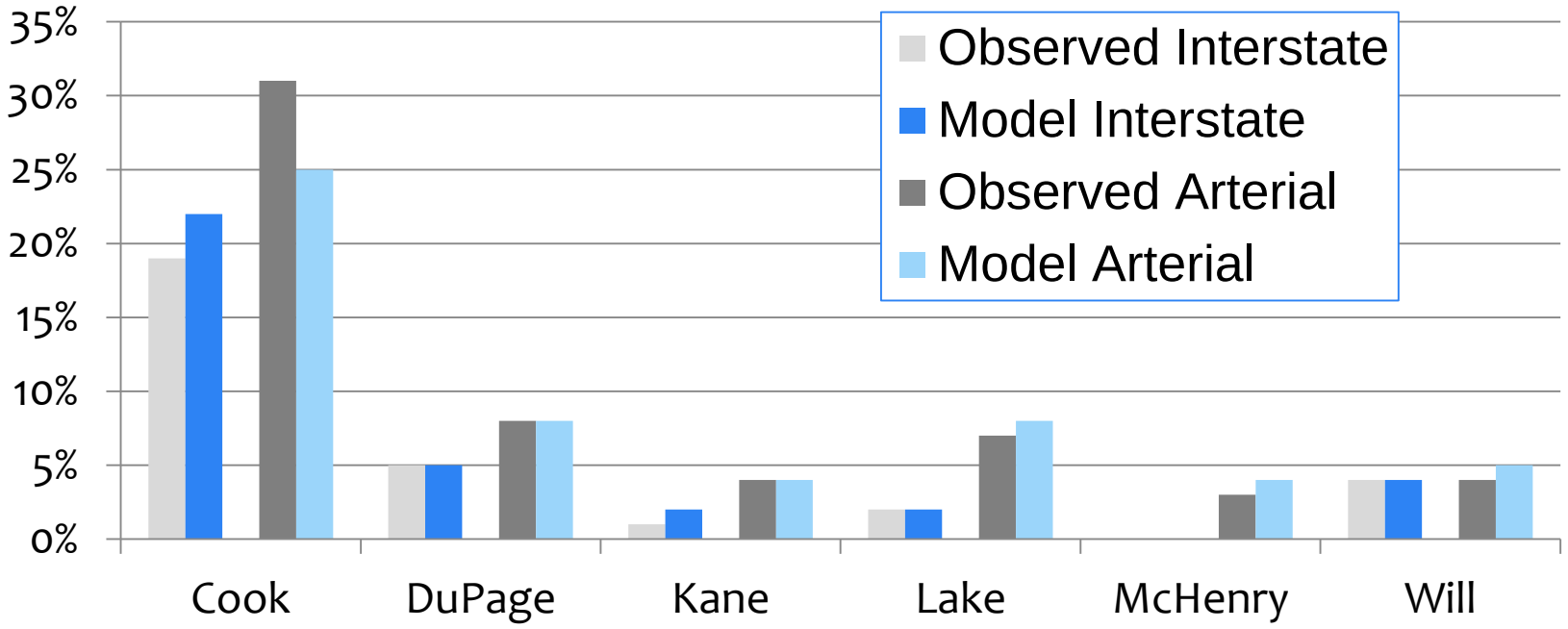
Only zones with at least 100 transit trips included.

Share of Daily Vehicle Miles Traveled

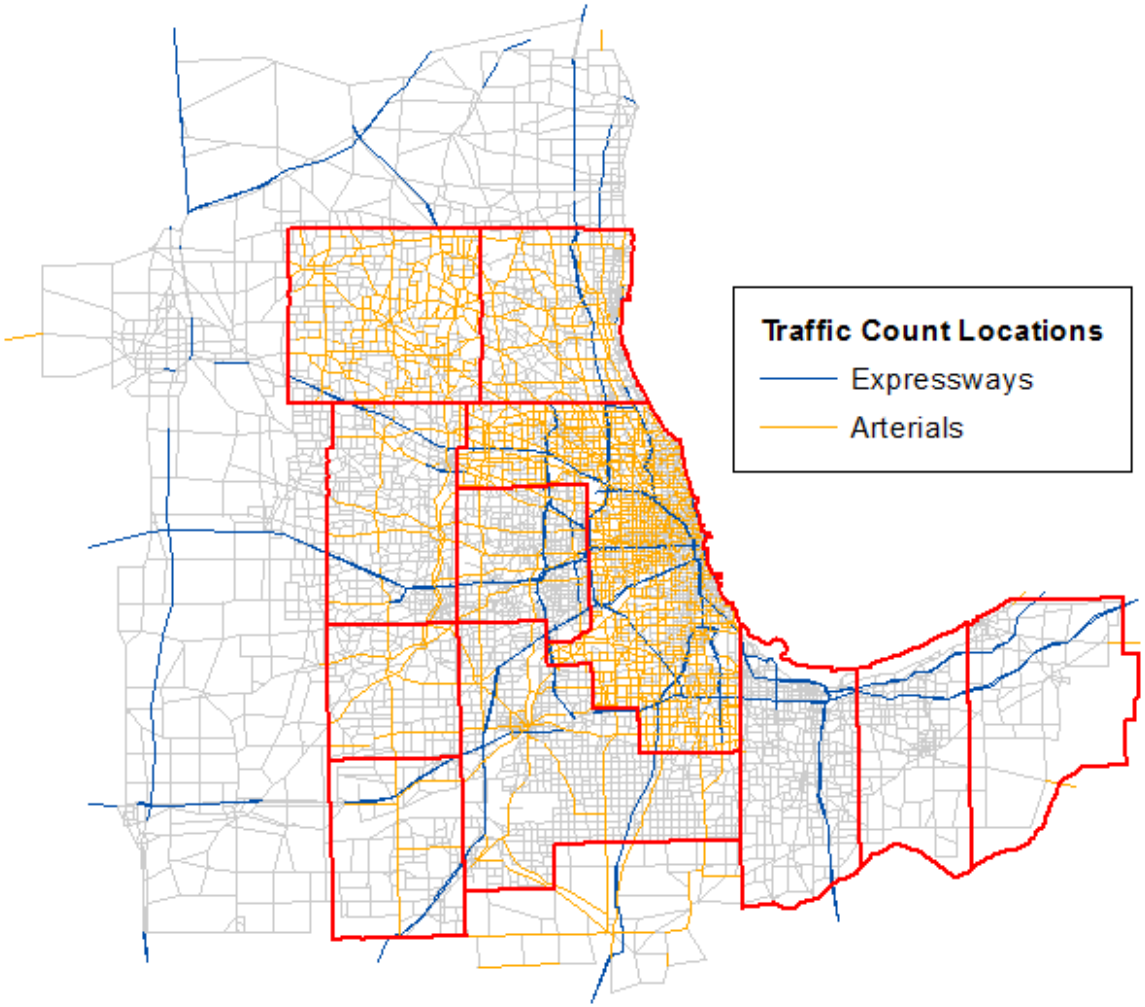


Source: 2008 Illinois Travel Statistics

Share of Daily Vehicle Miles Traveled

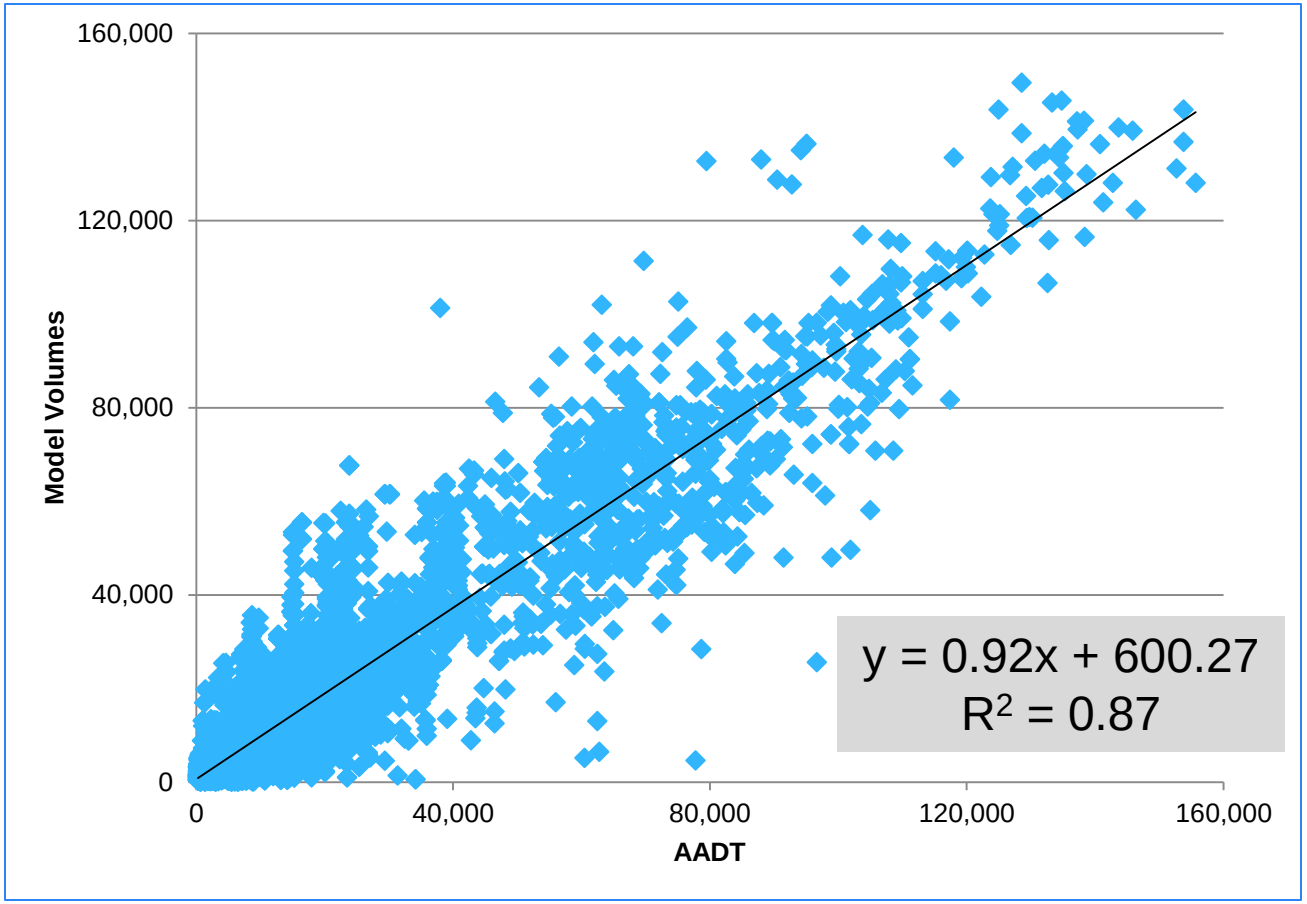


Traffic Count Locations



Daily Vehicle Miles Traveled

	Directional Links	Observed VMT	Model VMT	% Difference
Expressway	2,354	72,205,335	77,664,680	7.6%
Arterial	8,957	50,886,184	47,036,446	-7.6%
Total	11,311	123,091,519	124,701,126	1.3%


160,000
120,000
80,000
40,000
0
Model Volumes
0
40,000
80,000
120,000
160,000
AADT
y = 0.92x + 600.27
R2 = 0.87

Root Mean Square Error

Volume Range	Links	AADT	RMSE	% RMSE
0	2,640	2,670	2,003	75.0%
10000	5,529	9,233	4,435	48.0%
20000	1,936	18,641	7,182	38.5%
30000	348	29,887	10,355	34.6%
40000	153	38,731	11,981	30.9%
50000	96	49,942	14,762	29.6%
60000	152	60,397	13,463	22.3%
70000	154	69,208	13,853	20.0%
80000	97	79,534	15,121	19.0%
90000	59	89,127	13,204	14.8%
100000	52	99,839	12,106	12.1%
110000	36	108,230	10,237	9.5%
120000+	59	128,396	7,007	5.5%

VMT by Time-of-Day

Time Period	Observed VMT	Model VMT	% Difference
8:00 pm-6:00 am	10,659,621	5,639,727	-47.1%
6:00 am-10:00 am	12,414,714	15,159,101	22.1%
10:00 am-2:00 pm	11,992,712	13,622,467	13.6%
2:00 pm-8:00 pm	21,377,587	20,642,409	-3.4%
DAILY	56,444,634	55,063,704	-2.4%

Daily Transit Boardings

	Observed	Model	Difference
Commuter Rail	320,091	323,631	1.1%
Heavy Rail	666,515	671,809	0.8%
Bus	1,070,172	1,083,734	1.3%
TOTAL	2,056,777	2,079,173	1.1%

Source: 2010 ridership reports

Thank You!

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312-386-8768

View the full model validation report:
www.cmap.illinois.gov/modeling