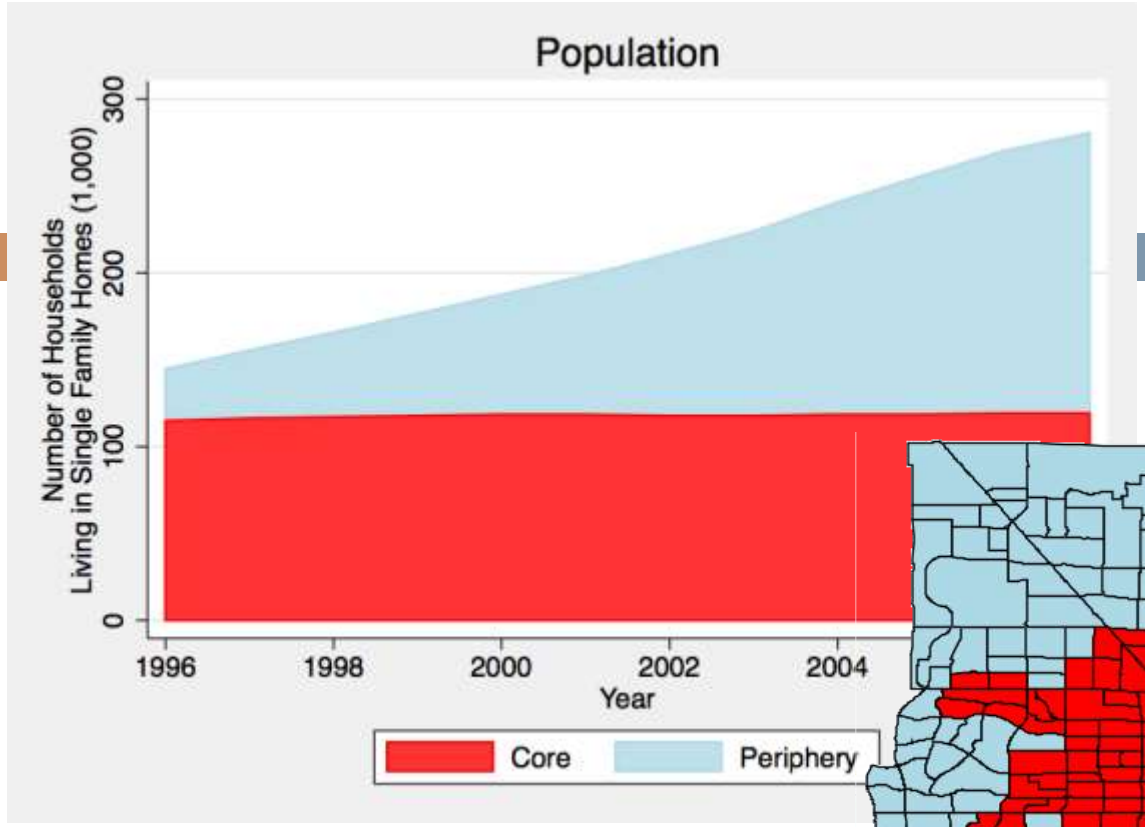
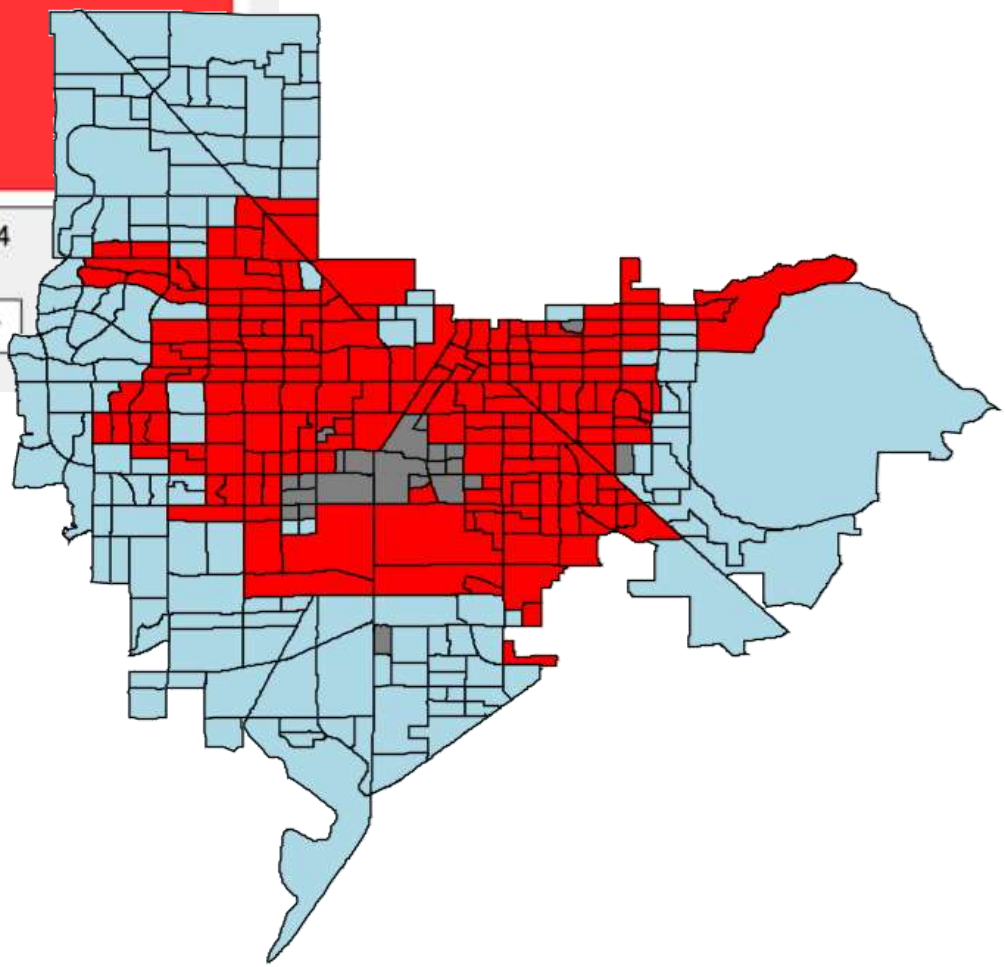
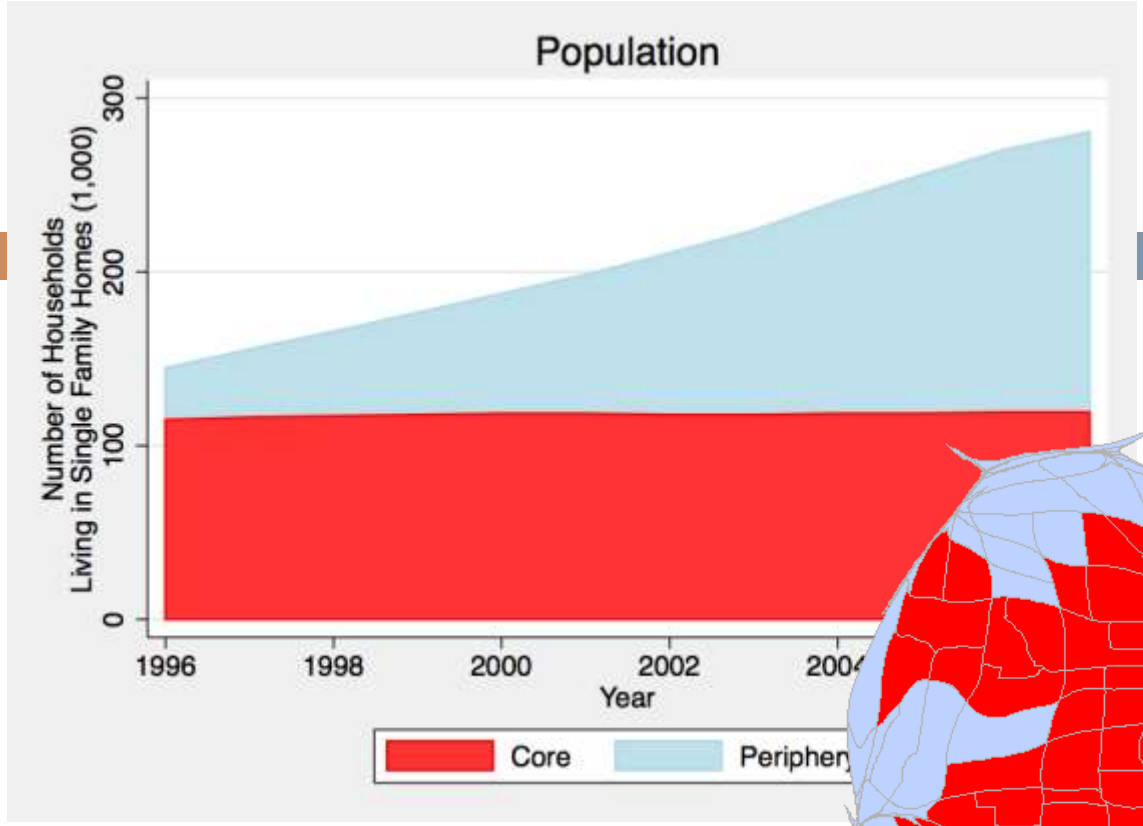
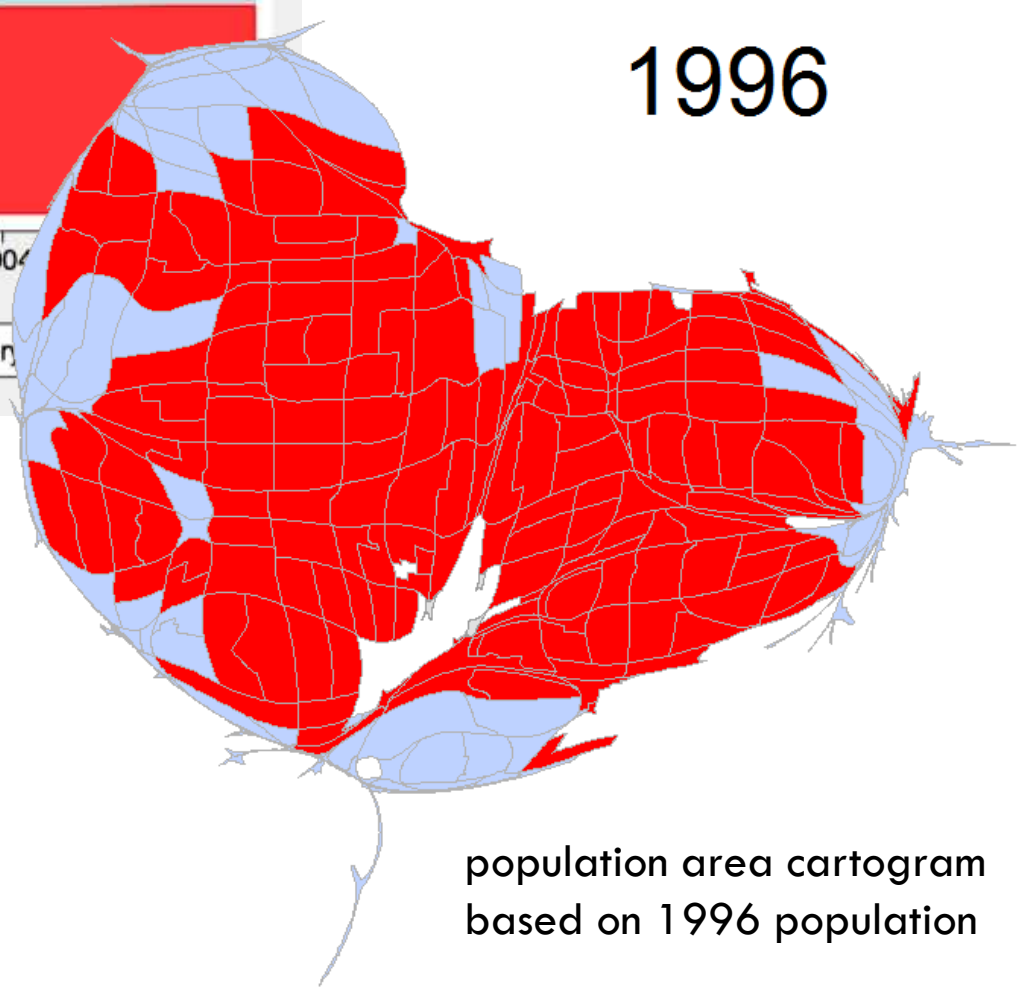
COUNTERFACTUAL SCENARIOS TO ESTIMATE DRIVERS OF DEMAND CHANGES

Christa Brelsford,
Santa Fe Institute


Population
Number of Households Living in Single Family Homes (1,000)
0
100
200
300
1996
1998
2000
2002
2004
Year
Core
Periphery

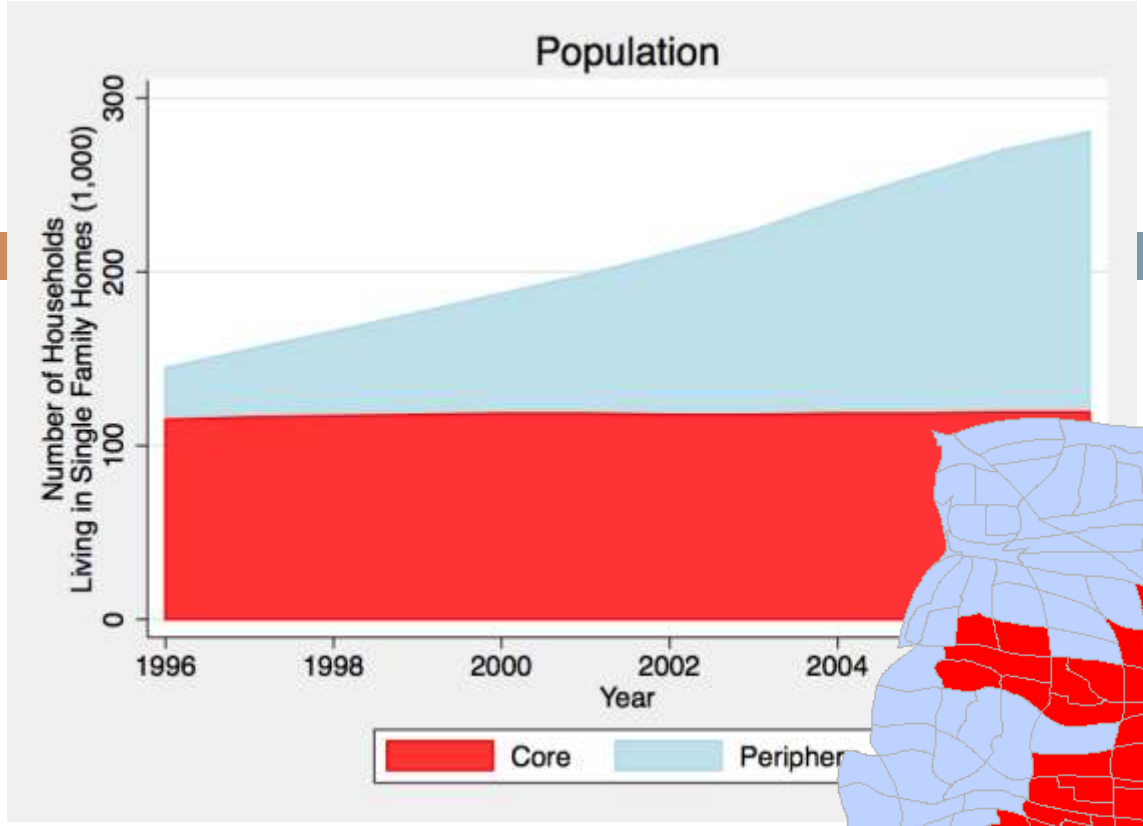




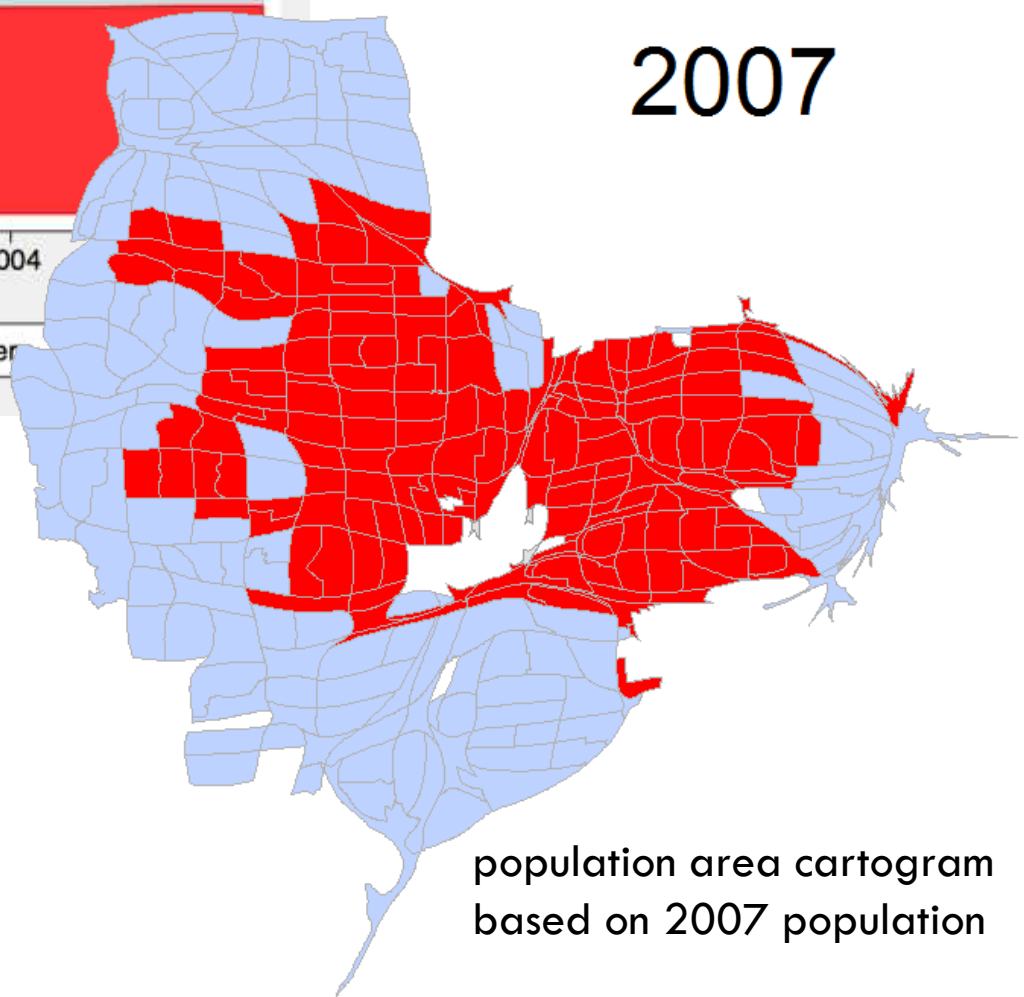


1996

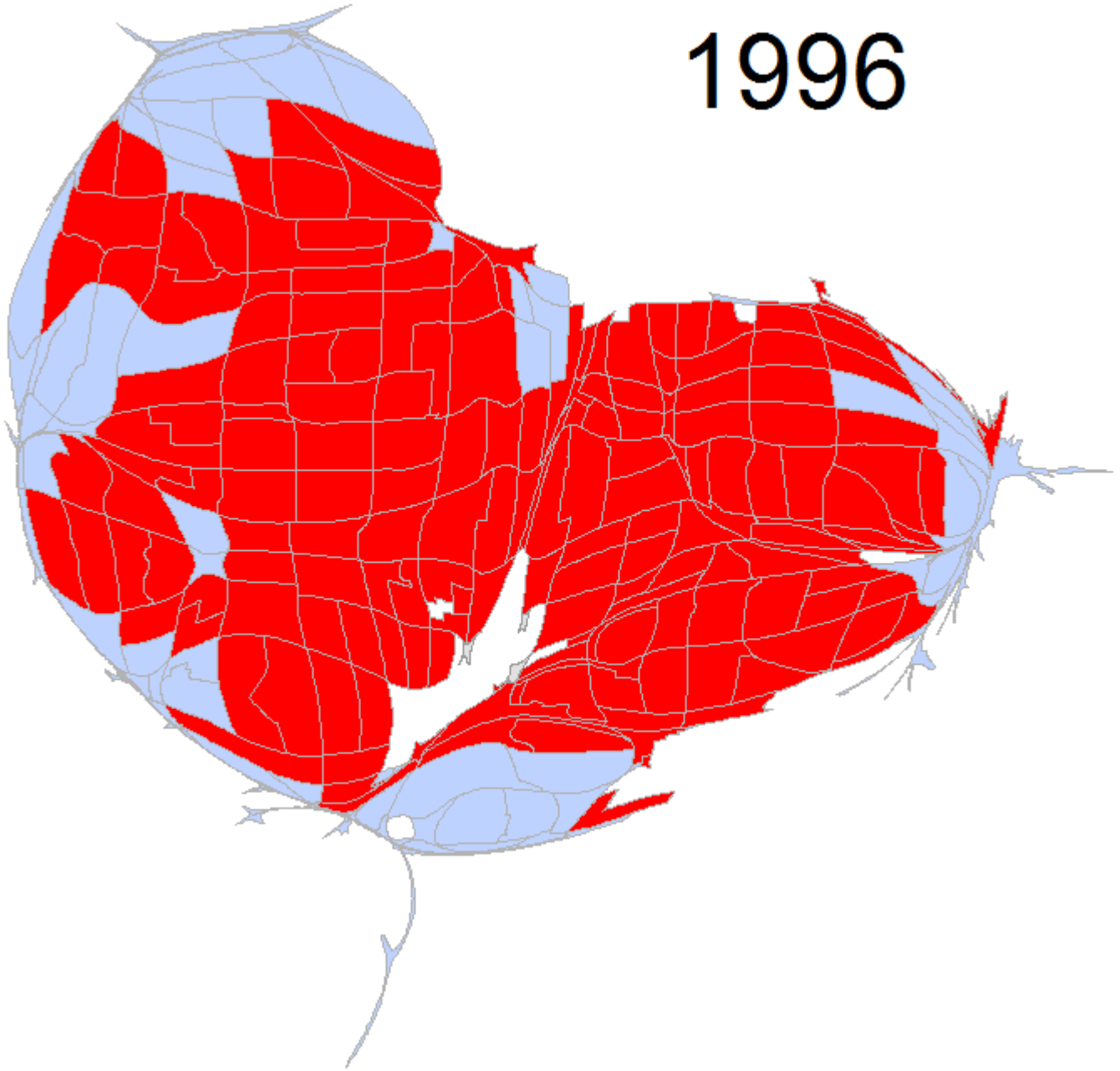
population area cartogram based on 1996 population

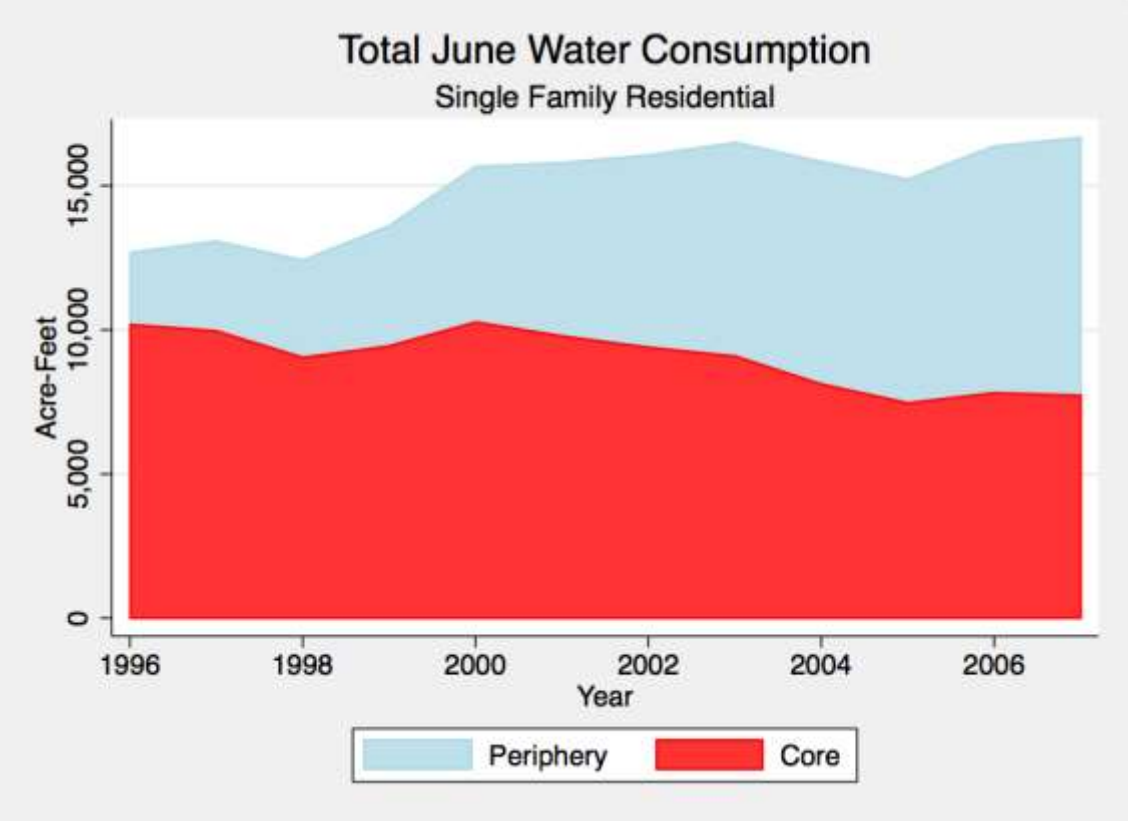


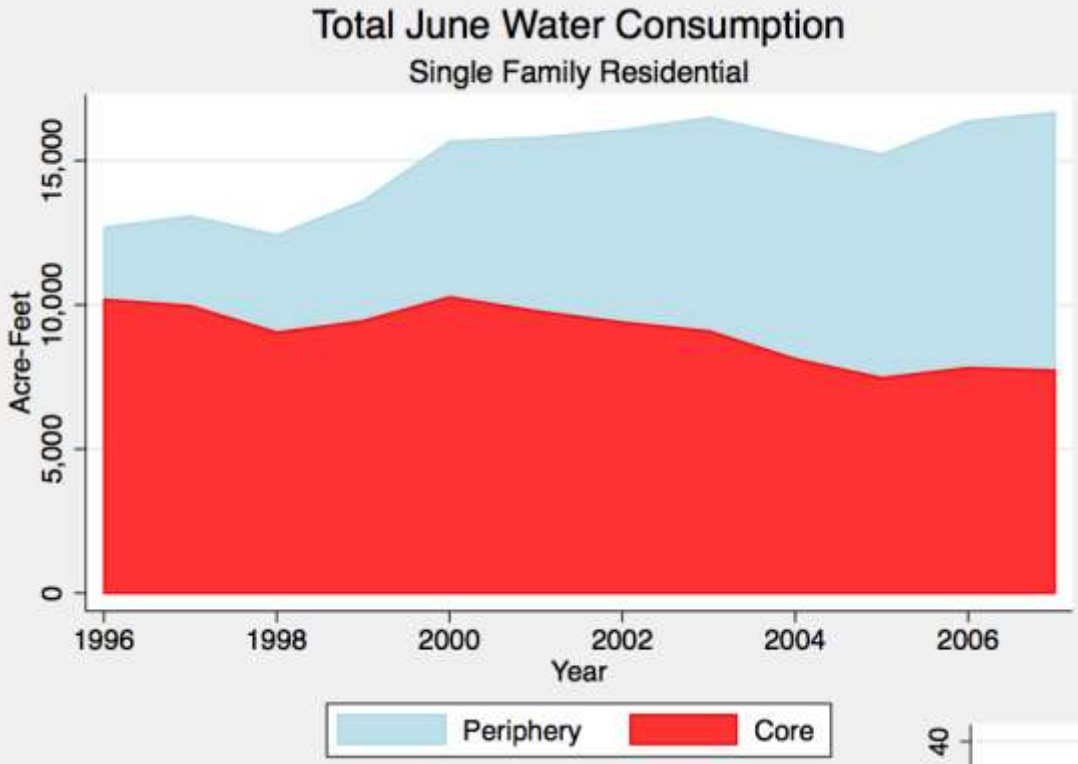
2007



population area cartogram based on 2007 population


1996


Total June Water Consumption
Single Family Residential
Acre-Feet
0
5,000
10,000
15,000
1996
1998
2000
2002
2004
2006
Year
Periphery
Core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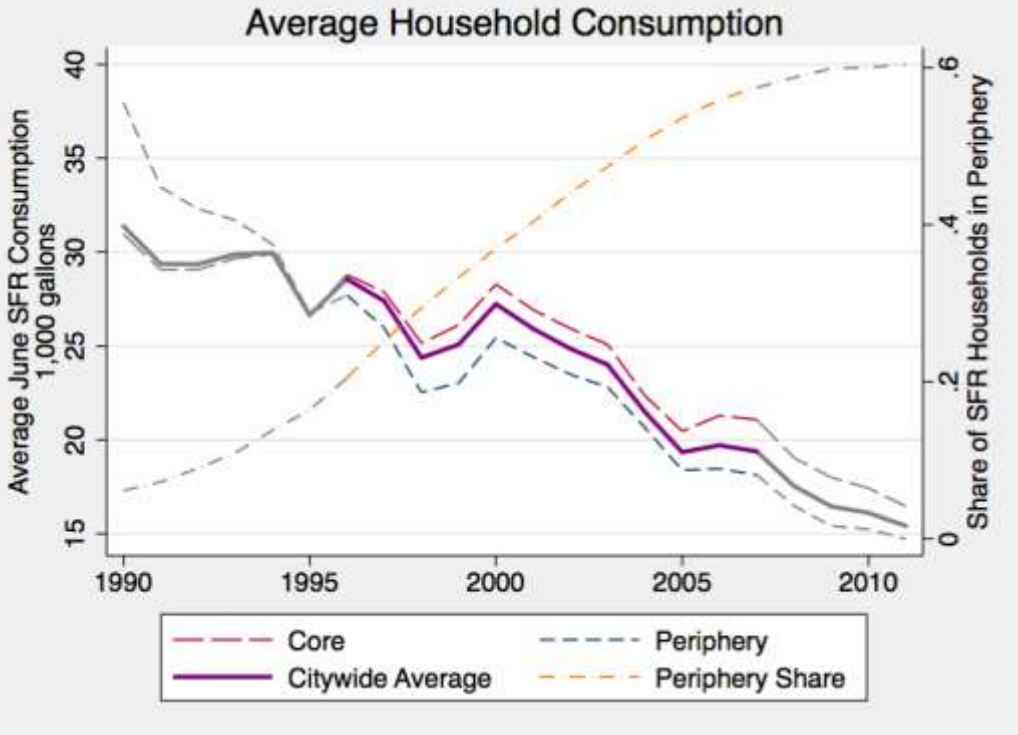

Average Household Consumption
Average June SFR Consumption
1,000 gallons
15
20
25
30
35
40
Share of SFR Households in Periphery
0
.2
.4
.6
1990
1995
2000
2005
2010
Core
Periphery
Citywide Average
Periphery Share

$$\boldsymbol{\beta}' = [\beta_0, \beta_1 \ldots \beta_n]$$

$$\boldsymbol{X_{it}} = [regressors]$$

$$\ln(W_{it}) = a + y_t + z_i + \boldsymbol{X_{it}\beta} + e_{it}$$

$$t \in [1996, 2007]$$

semi-log regression with spatial fixed effects and temporal dummy variables

Regressors

- living area
- bedrooms
- plumbing fixtures
- vintage
- pool ownership rate
- precipitation
- temperature
- dirt area
- vegetation area
- vegetation * temperature
- vegetation * precipitation
- dirt * temperature
- dirt * precipitation
- pools * temperature

	Year FE	Year FE + Controls	Year FE + Controls + Tract FE
Living Area (m^2)		0.00141***	0.00271**
Plumbing Fixtures		0.0445***	0.0155
Bedrooms		0.154***	0.0273
Pool Percentage		0.527***	0.373*
Pct Pool * Min Temp (% * C)		0.0180	-0.000402
Total June Precip (cm)		-0.0724	-0.0917***
Dirt * Min Temp (100 m^2 * C)		0.00306**	0.000603
Vegetation * Min Temp (100 m^2 * C)		-0.0109*	0.00347*
Area Dirt (100 m^2)		0.00619**	-0.0270***
Area Veg (100 m^2)		0.108***	0.217***
Min Temp (C)		-0.00435	0.00393
Vintage 1960 to 1984		-0.199***	0.484
Vintage 1984 to 1994		-0.204***	0.0819
Vintage 1994 to 2001		-0.456***	-0.0162
Vintage 2001 to 2004		-0.567***	-0.124
Vintage 2004 to 2007		-1.018***	-0.471
1996 Year Fixed Effect (baseline)	0	0	0
1997 Year Fixed Effect	-0.0437	-0.0272	-0.0239***
1998 Year Fixed Effect	-0.158***	-0.103***	-0.0860***
1999 Year Fixed Effect	-0.148***	-0.0690	-0.0597***
2000 Year Fixed Effect	-0.0552	-0.0158	-0.0126
2001 Year Fixed Effect	-0.103**	-0.0710***	-0.0770***
2002 Year Fixed Effect	-0.143***	-0.102***	-0.107***
2003 Year Fixed Effect	-0.178***	-0.123***	-0.126***
2004 Year Fixed Effect	-0.299***	-0.220***	-0.216***
2005 Year Fixed Effect	-0.406***	-0.257***	-0.246***
2006 Year Fixed Effect	-0.395***	-0.230***	-0.230***
2007 Year Fixed Effect	-0.417***	-0.241***	-0.252***
Constant	3.291***	3.374***	2.875***
R-squared	**0.139**	**0.878**	**0.978**

COUNTERFACTUAL SCENARIOS

1. How did changing household infrastructure characteristics like house size, number of bedrooms or plumbing fixtures, and pool prevalence influence household water consumption?

2. How did changing vegetation area per household influence household consumption?

3. How did population growth and new construction influence household water consumption?

Scenario Estimation Method

- In each scenario, the variable in question is held constant at the 1996 levels.

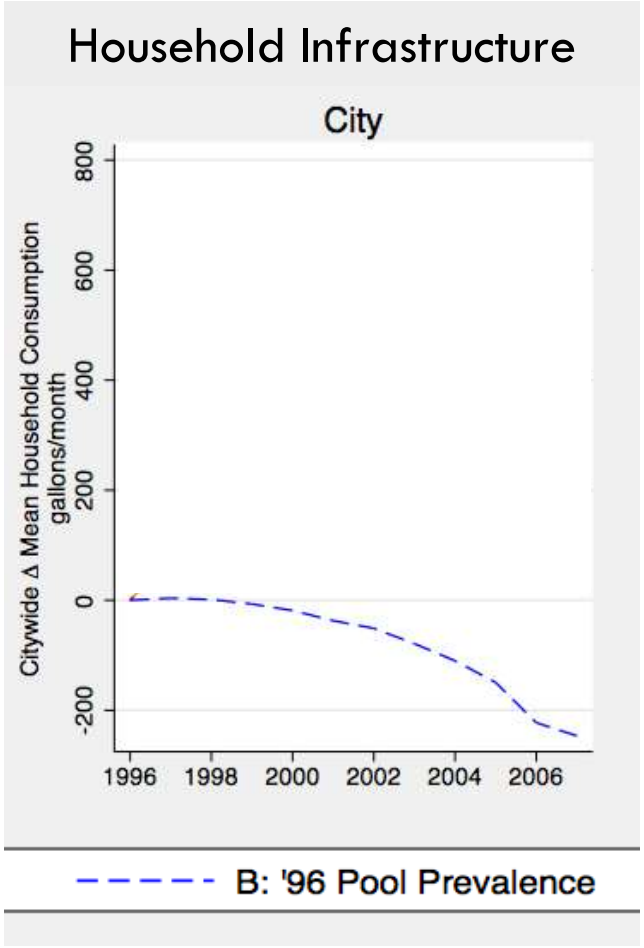
$$\tilde{x}_{it} = x_{i1996}$$

- Using our regression results, we compare expected consumption under the scenario to true consumption.
- The actual changes that occurred in X caused the difference between measured and scenario consumption.

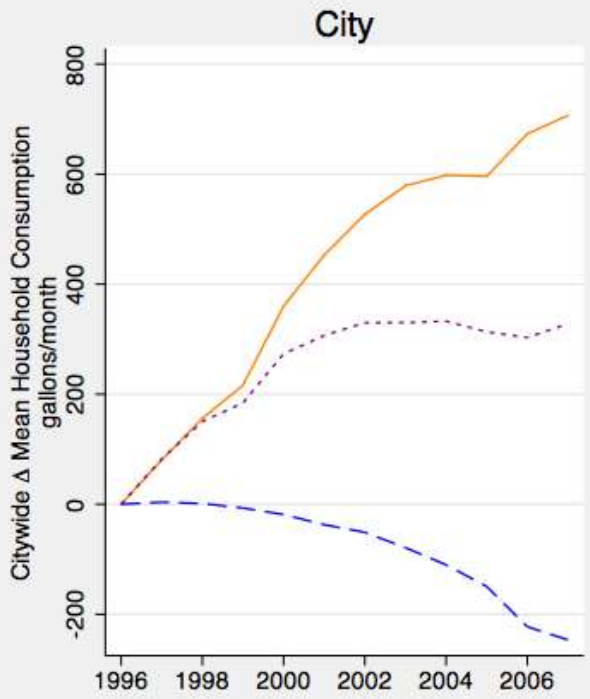
Pools Example

- Pool ownership rates declined by a small amount in both the periphery and core between 1996 and 2007.
- The estimated coefficient on pool ownership is large and positive: in a given neighborhood, an increase in pool ownership from 0% to 100% increases average household consumption there by 52%
- In the pools scenario, we estimate what household consumption would have been if pool ownership rates stayed at 1996 levels.
- The decline in pool ownership caused a decline in household consumption.

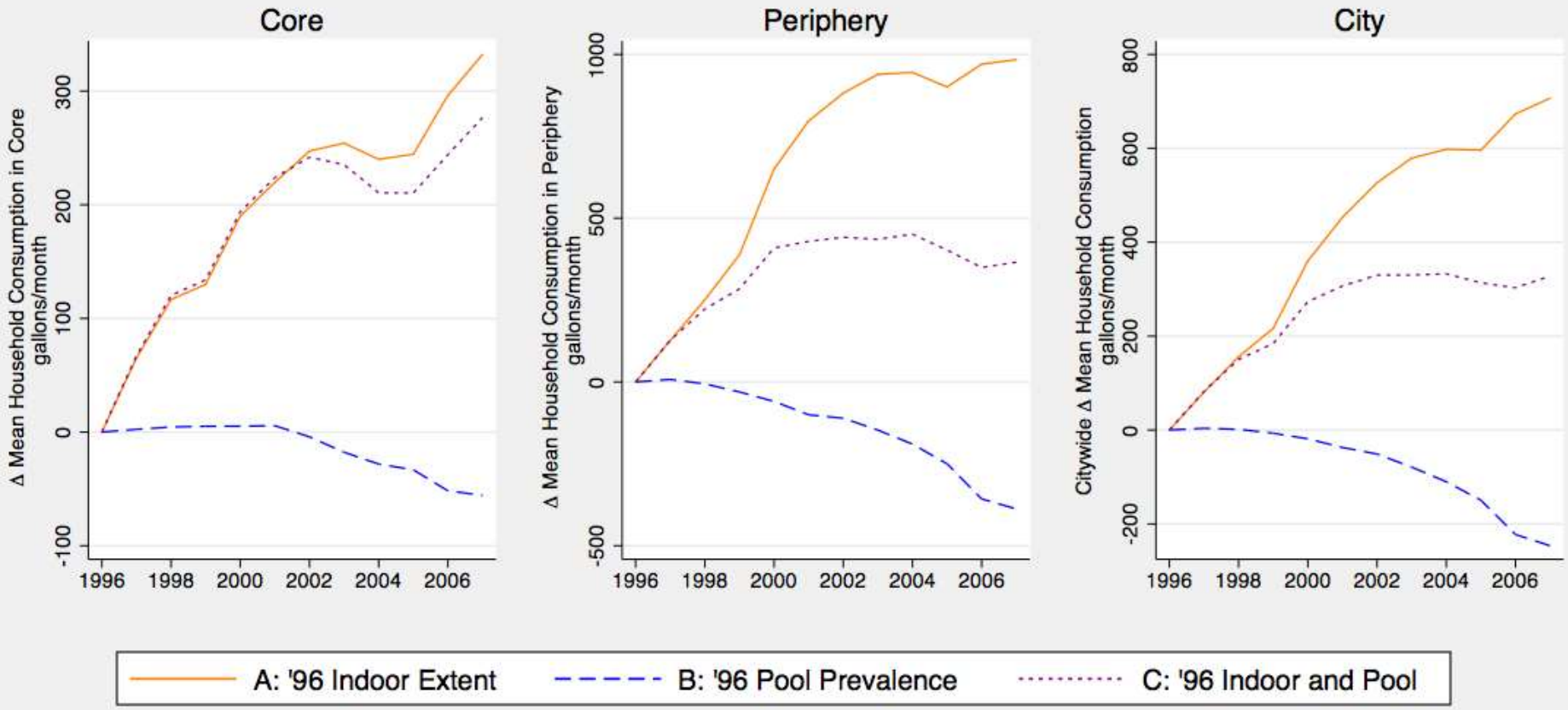
Household Infrastructure

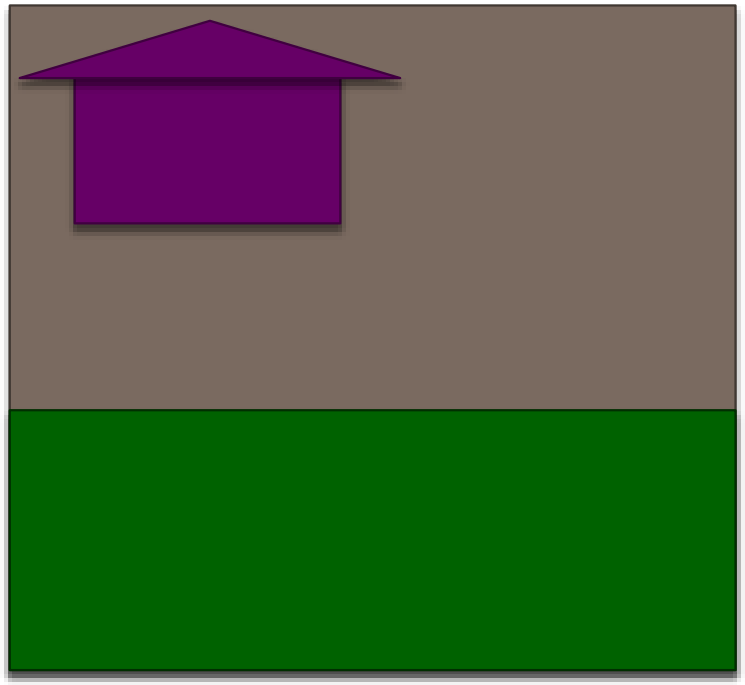


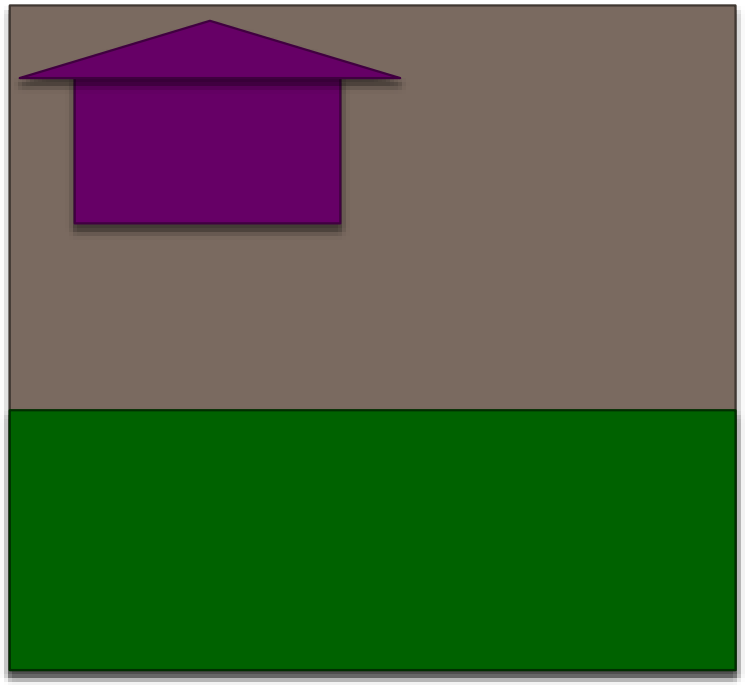
Household Infrastructure

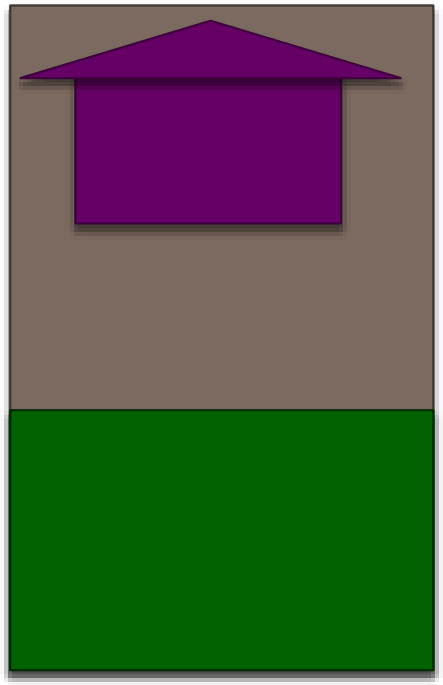


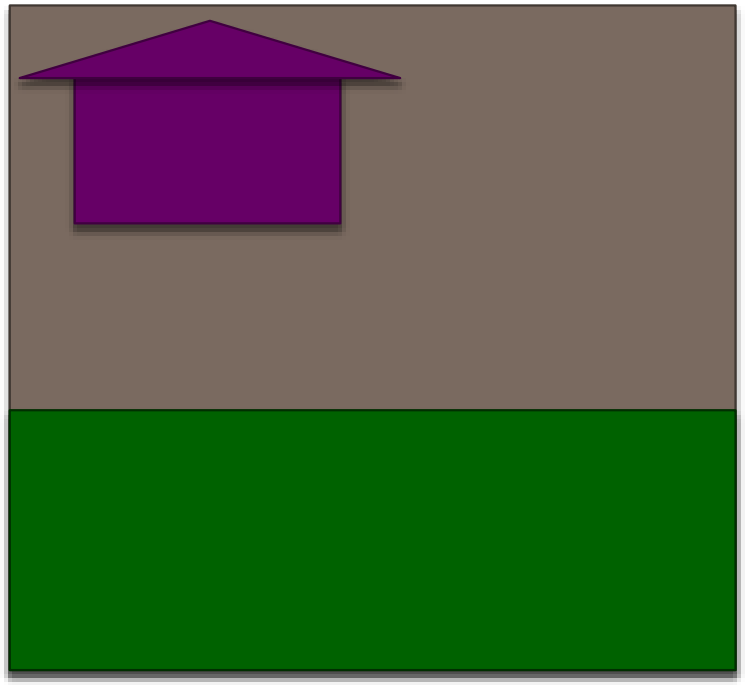
Question One: Household Infrastructure

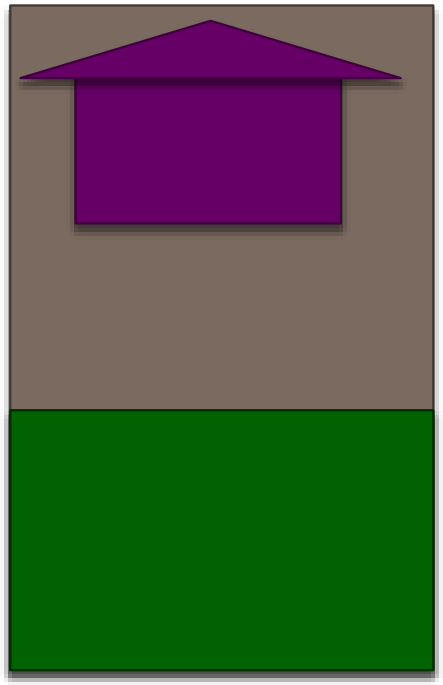


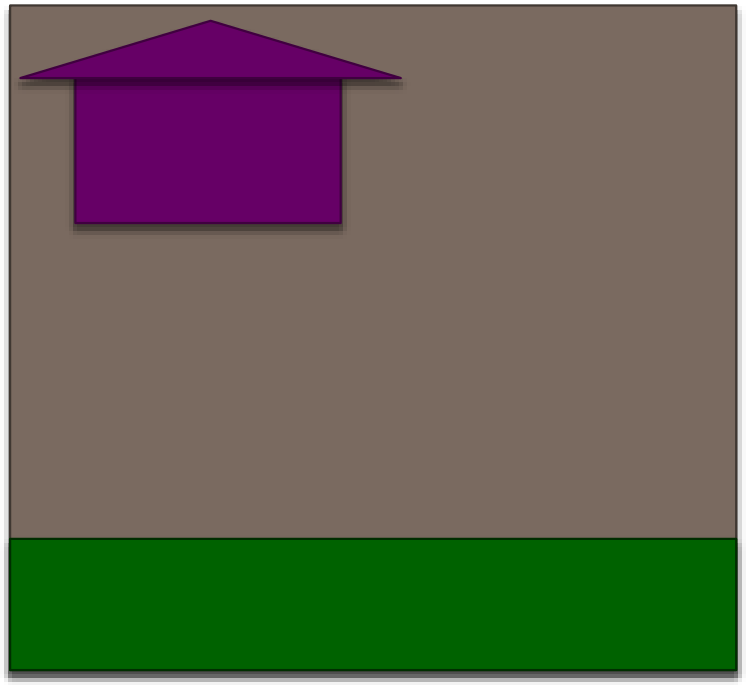




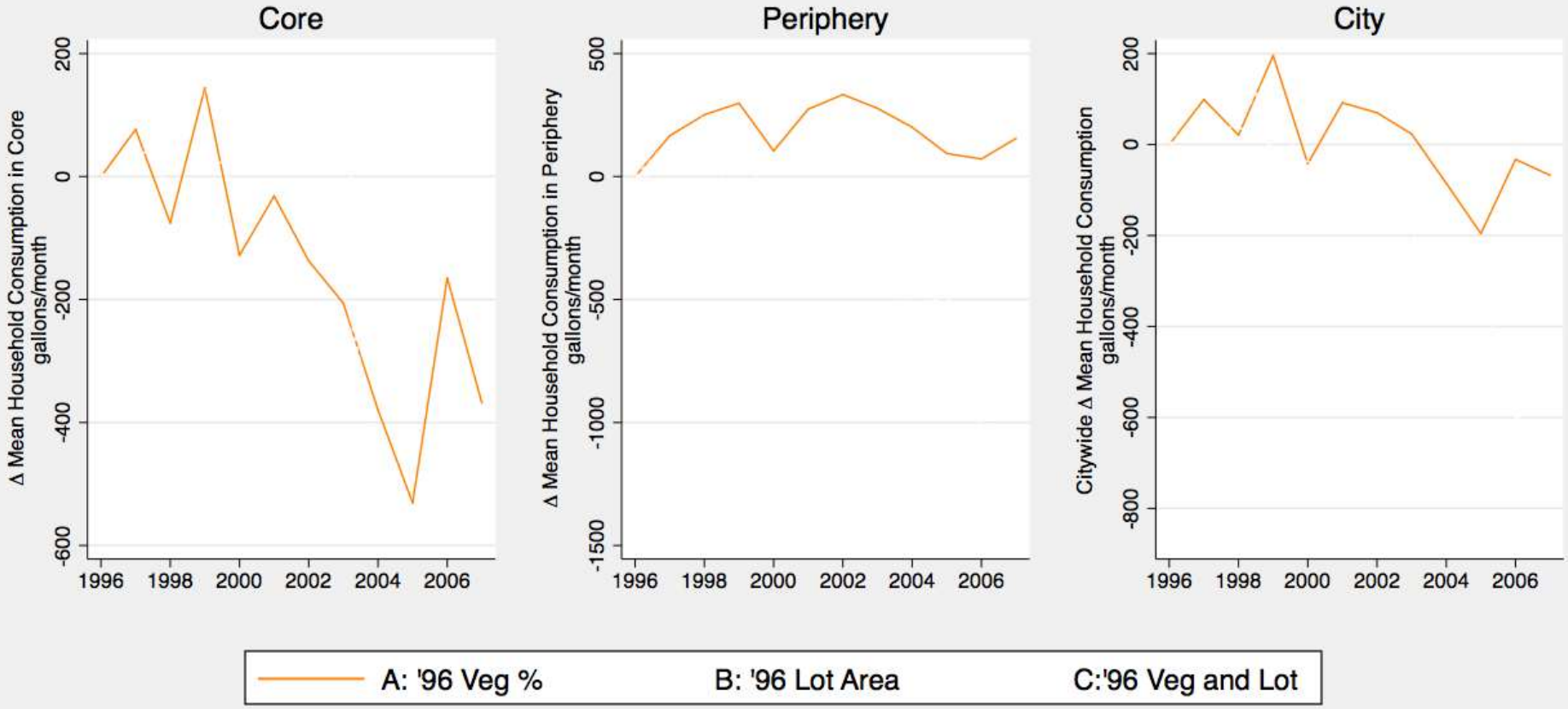








Question Two: Vegetation Change



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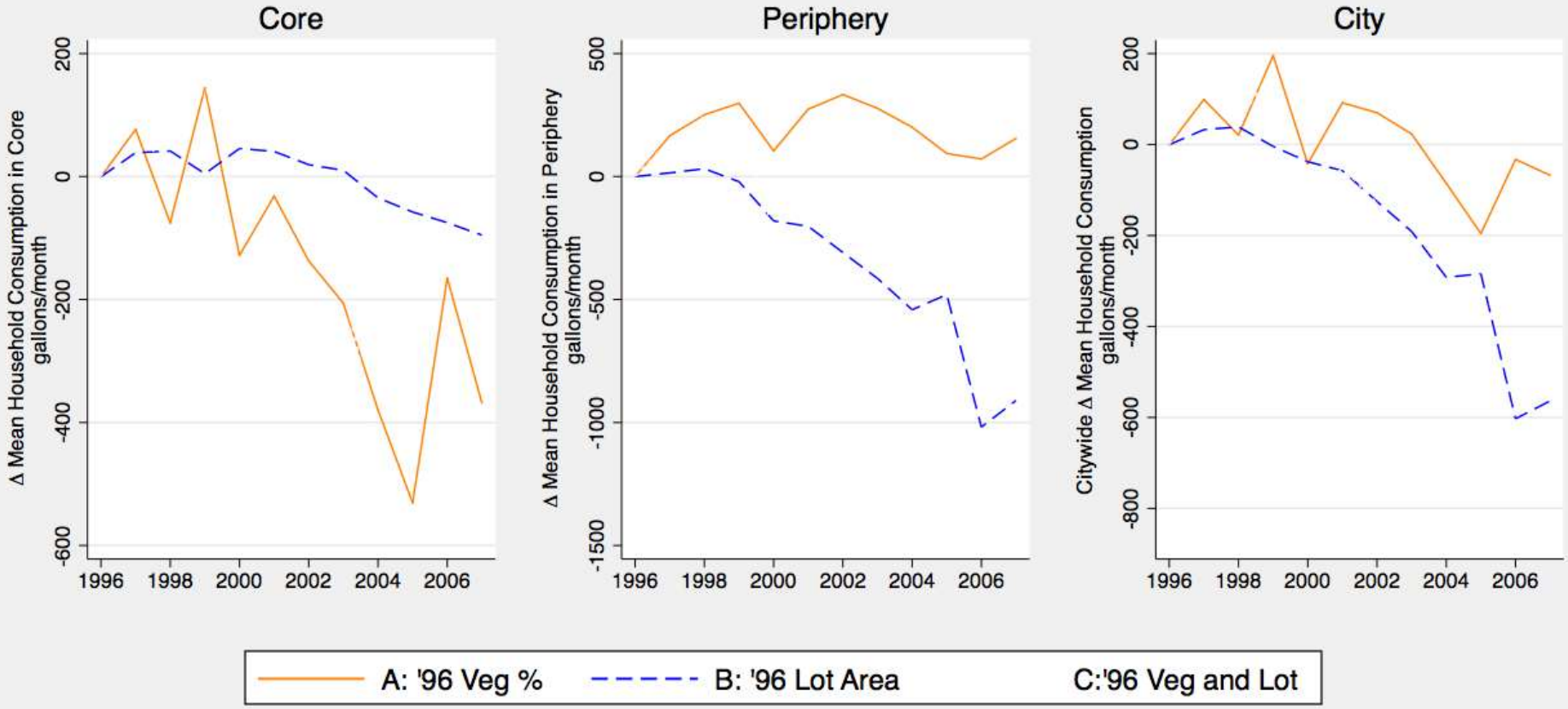

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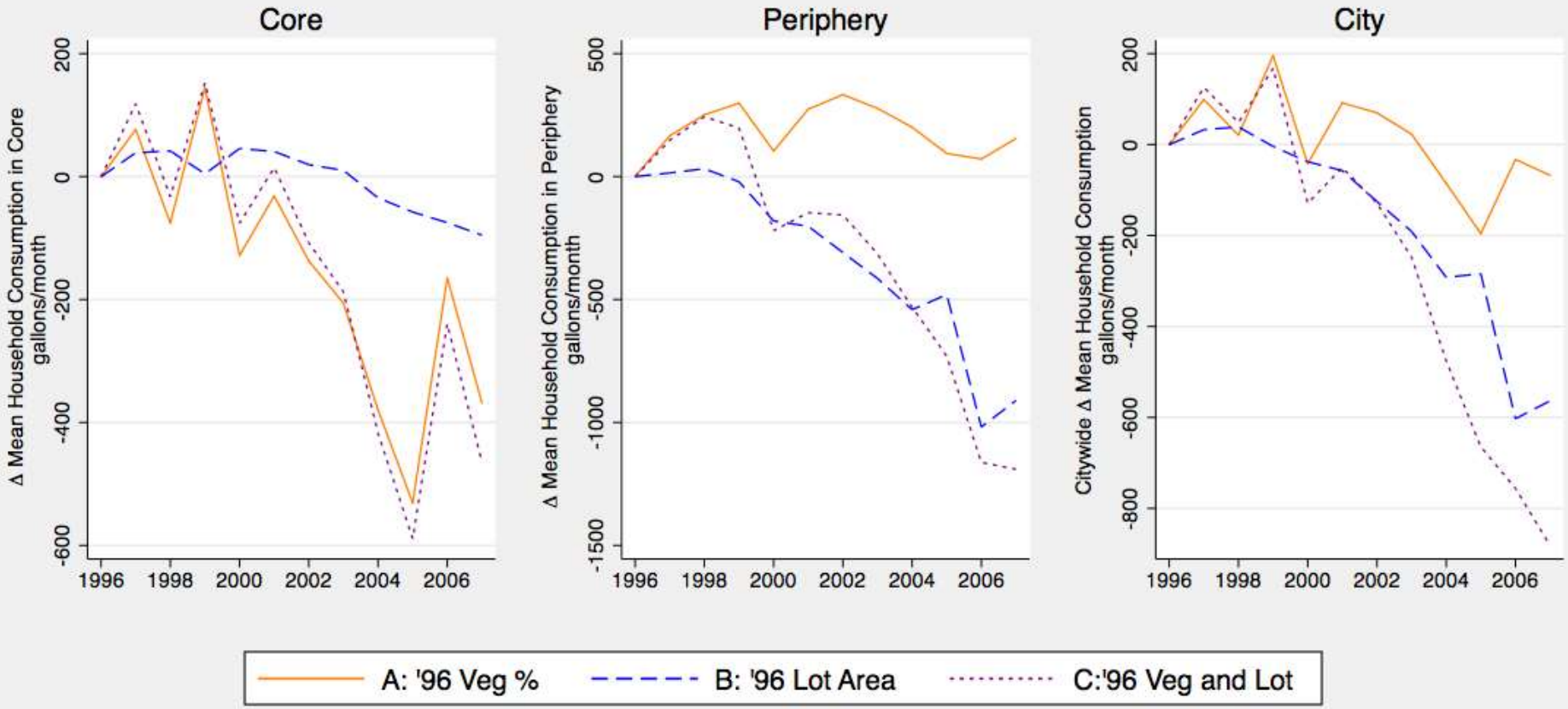
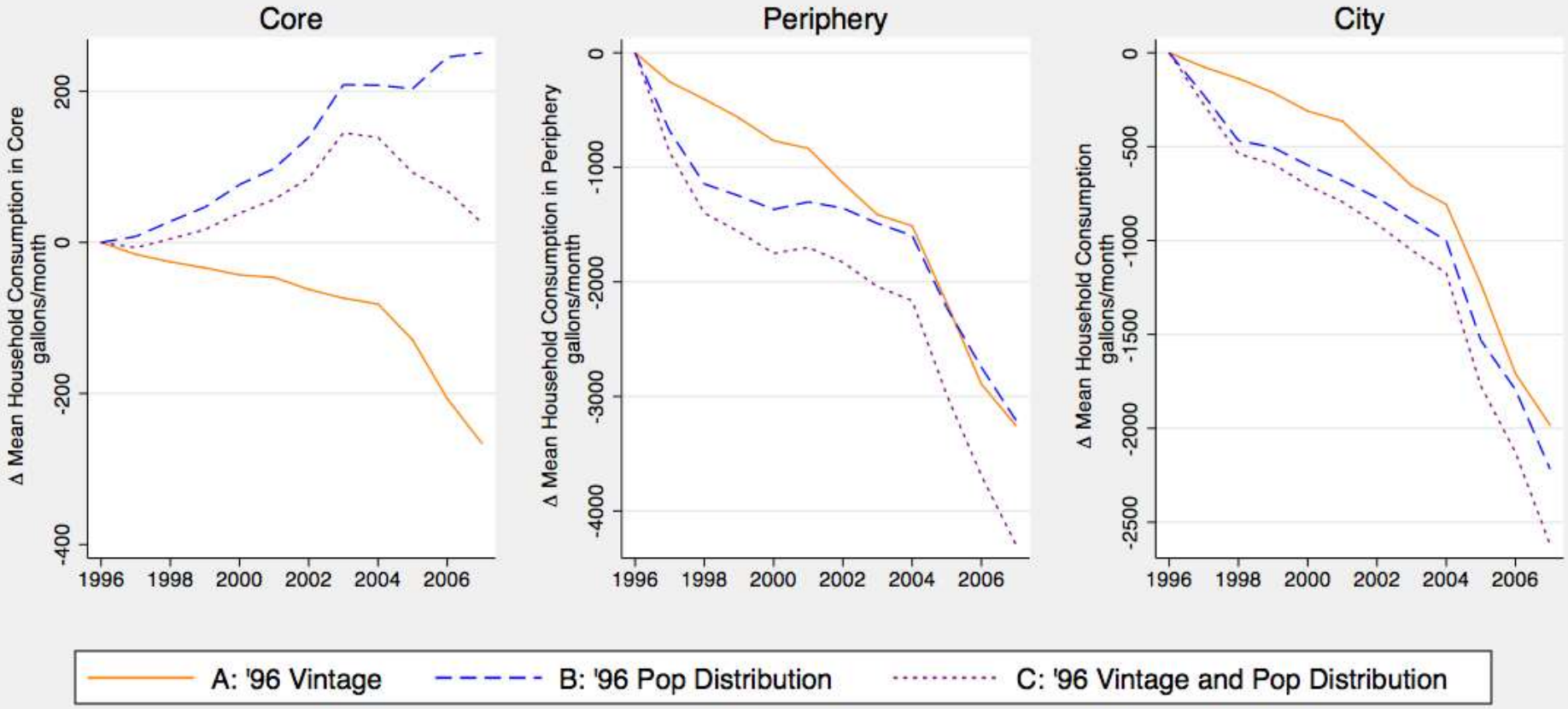


Question Three: Population Growth



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2. How did changing vegetation area per household influence household consumption?

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Conclusions

- More water efficient new construction in conjunction with population growth was the single largest driver of Las Vegas' decline in household water consumption.
- In the city core, the largest explainable driver of changes in household consumption is the observed decline in vegetation area.

THANKS

christa@santafe.edu