Consumer Advertising Competition in Prescription Drugs

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Consumer Advertising

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  - May also generate returns for competitors.
- What are the welfare implications of advertising?
  - "Business Stealing": shifting consumers from one firm to another
  - "Market Expanding": informing consumers about a product

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- Unobserved market-level heterogeneity may increase or decrease the returns to advertising.

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  - We exploit exogenous shocks to local advertising markets caused by the US political process, using both primary schedules and competitiveness of races.
  - Reduced form analysis: IV regressions of revenue on ad levels.
  - Structural analysis: Finite-horizon 2-player game. Transition matrix for consumers and policy functions for firms.

Motivation: Our Context

- Study advertising competition in the market for statins (anti-cholestorol drugs).
- Marketing drugs costs pharmaceutical firms more than R&D
  - Pfizer (Lipitor): Selling expenses are over 2X R&D expenses
  - DTCA is 11.3% of overall promotion spending
  - Industry-wide, $3 billion spend on direct to consumer advertising (DTCA) in 2012
- New Zealand is the only other country that allows DTCA
  - Presence of agency and insurance complicate welfare calculations
- Existing research finds evidence of market expansion, effects of physician visits and drug adherence (Berndt 2005, Jin and Iizuka 2005, Wosinska 2002, Wosinska 2008, Rosenthal et al. 2003, Berndt et al. 1995, Shapiro 2013).

Preview of Results

- Statin advertising has a large business stealing effect among branded firms, implying that strategic interactions are important in this context.

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- Statin advertising has a large business stealing effect among branded firms, implying that strategic interactions are important in this context.
- Branded statin advertising has a positive, statistically significant effect on demand for non-advertised and generic statins, which would not be detected via OLS.
- Structural decomposition of ads says almost 60% of advertising is directly in response to rival ads, instead of in response to market conditions.
    - Eliminating these ads alone would have a more modest effect on the total number of patients taking statins.

Data Sources

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- Estimation sample: 190 DMAs, 17 months, 4 advertised drugs plus "all other" (including generics)

Measurement Challenges

- Unobserved heterogeneity and strategic interactions make measurement difficult.
- Example: Demand shock increases returns to advertising; ads are business stealing.
  - Positive shock to Lipitor demand increases Lipitor advertising
  - Increase in Lipitor advertising increases Crestor advertising
  - OLS measures a market expansion effect of Crestor's advertising where there is no causal effect
  - OLS likely underestimates own effect for Lipitor ads.
- Direction of OLS bias depends on how demand shocks and rival advertising affect advertising decisions.

Implications

Challenge of regressing my market share on advertising levels ▸ Bias:

	A positive demand shock...	
	Increase Marginal Benefit of Advertising	Decrease Marginal Benefit of Advertising
Rival advertising is...		
Business Stealing	Both advertise more; Own effect bias: ↑ Rival effect bias: ↑	Both advertise less; Own effect bias: ↓ Rival effect bias: ↑
Market Expanding	I advertise more, rival less; Own effect bias: ↑ Rival effect bias: ↓	I advertise less, rival more; Own effect bias: ↓ Rival effect bias: ↓

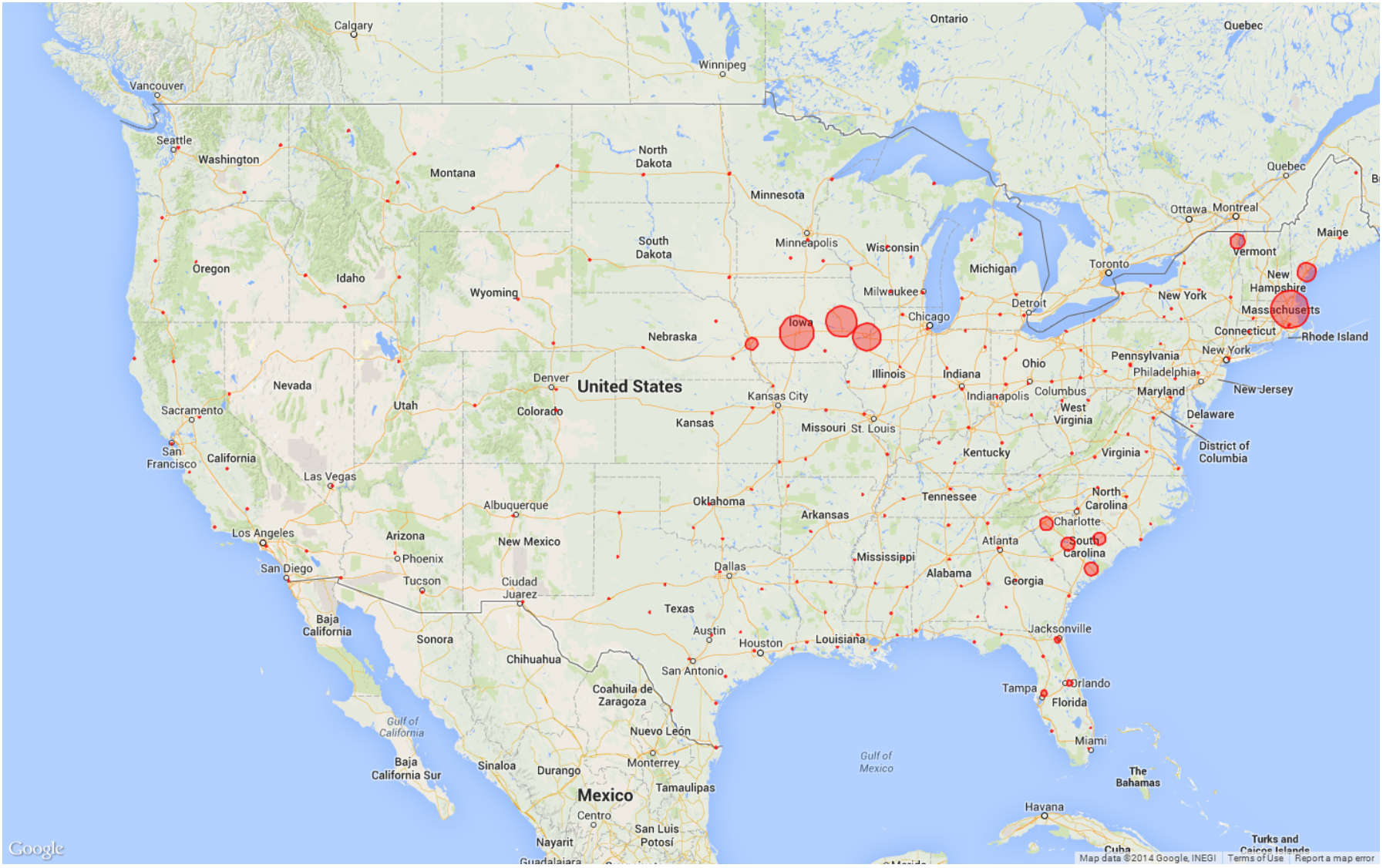
Instrument

- Political primary/caucus schedule and competitiveness of races lead different markets to get large amounts of political advertising at different points in the year.
- Political advertising displaces drug advertising. For example, March 2008:
  - Cincinnati OH, Charlotte NC, and Indianapolis IN have thousands of political ads (1,192, 1,471 and 1,996 respectively); zero local statin ads.
  - Seattle WA has zero political ads, 57 local statin ads; Miami-Ft Lauderdale FL has zero political ads, 51 local statin ads.
- Fast-forward to Oct 2008: Miami-Ft Lauderdale has 12,422 political ads; 8 statin ads.

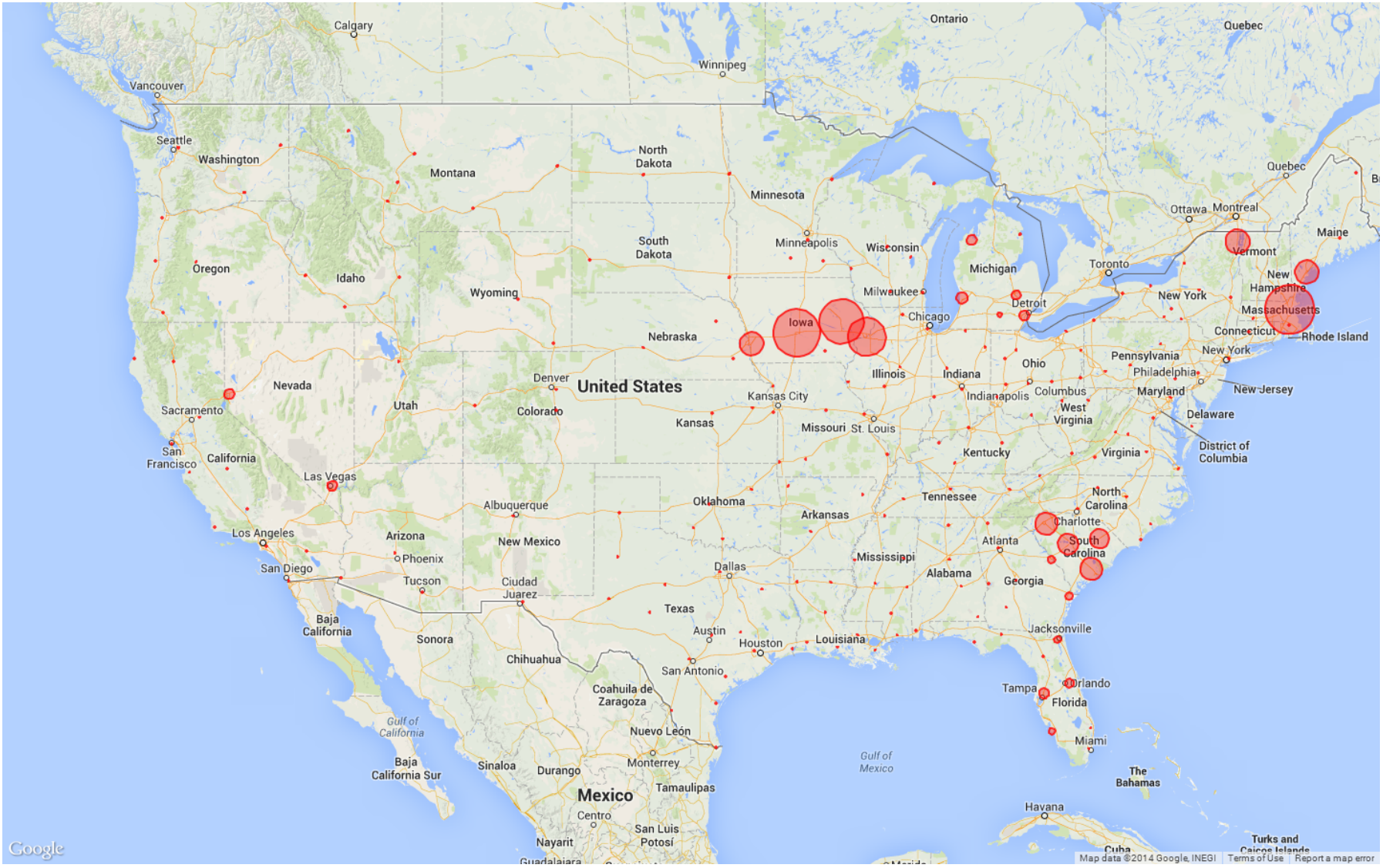
Political Advertising in the 2008 Election

- First billion dollar election, with more than twice the spending of 2004
- No incumbent for either primary.
  - contest between Clinton and Obama extended into June
  - strength of Obama's challenge was surprising
  - McCain clinched the Republican nomination in March
- Obama rejected public funding in the general election, relying on a larger amount of private funds.
  - substantial advertising spending in "swing states", including CO, FL, IN, MO, NV, NH, NM, NC, OH, PA, and VA
  - spent $740M, more than Kerry and Bush combined in 2004 ($640M)

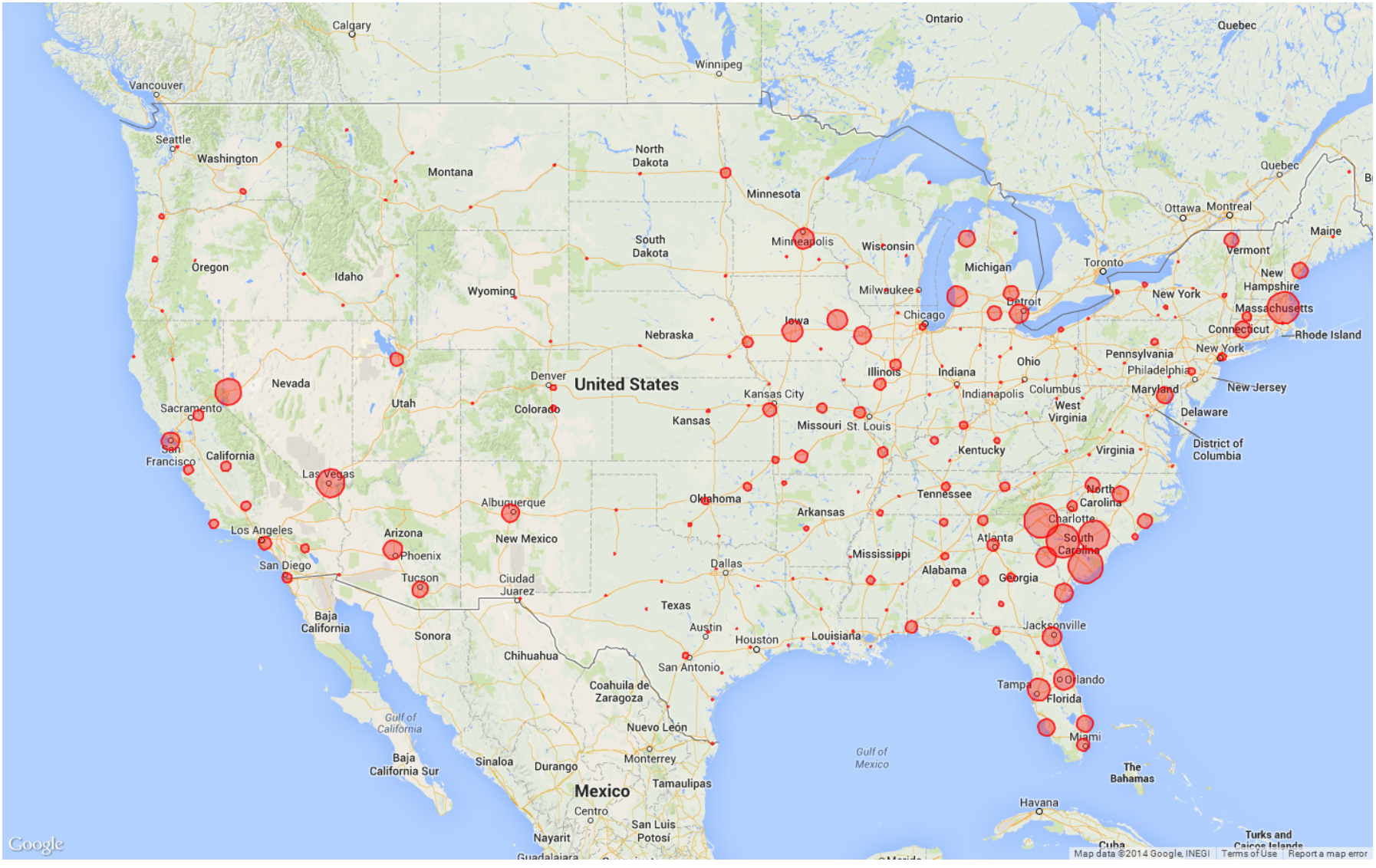
Political Ads, November 2007



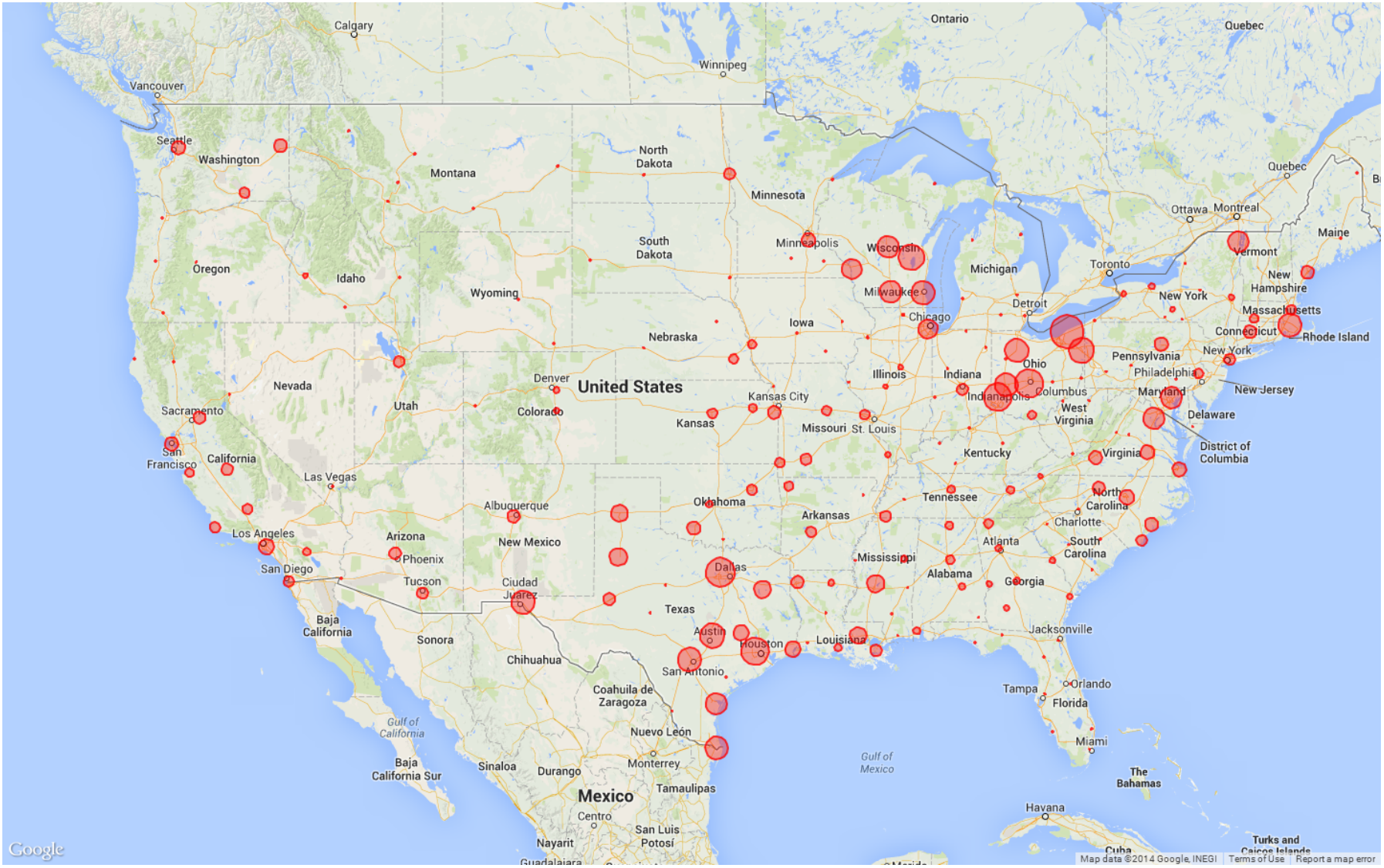
Political Ads, December 2007



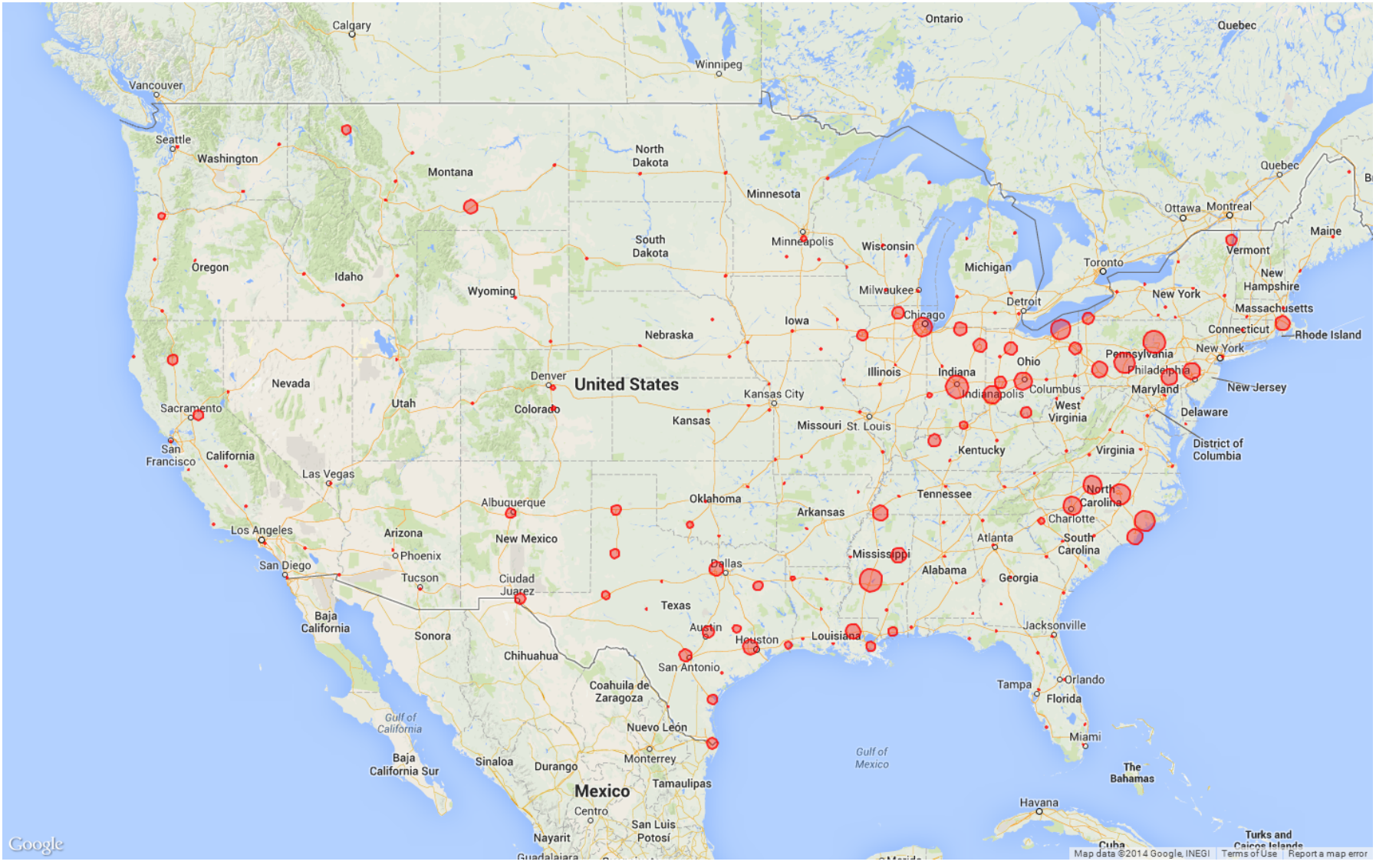
Political Ads, January 2008



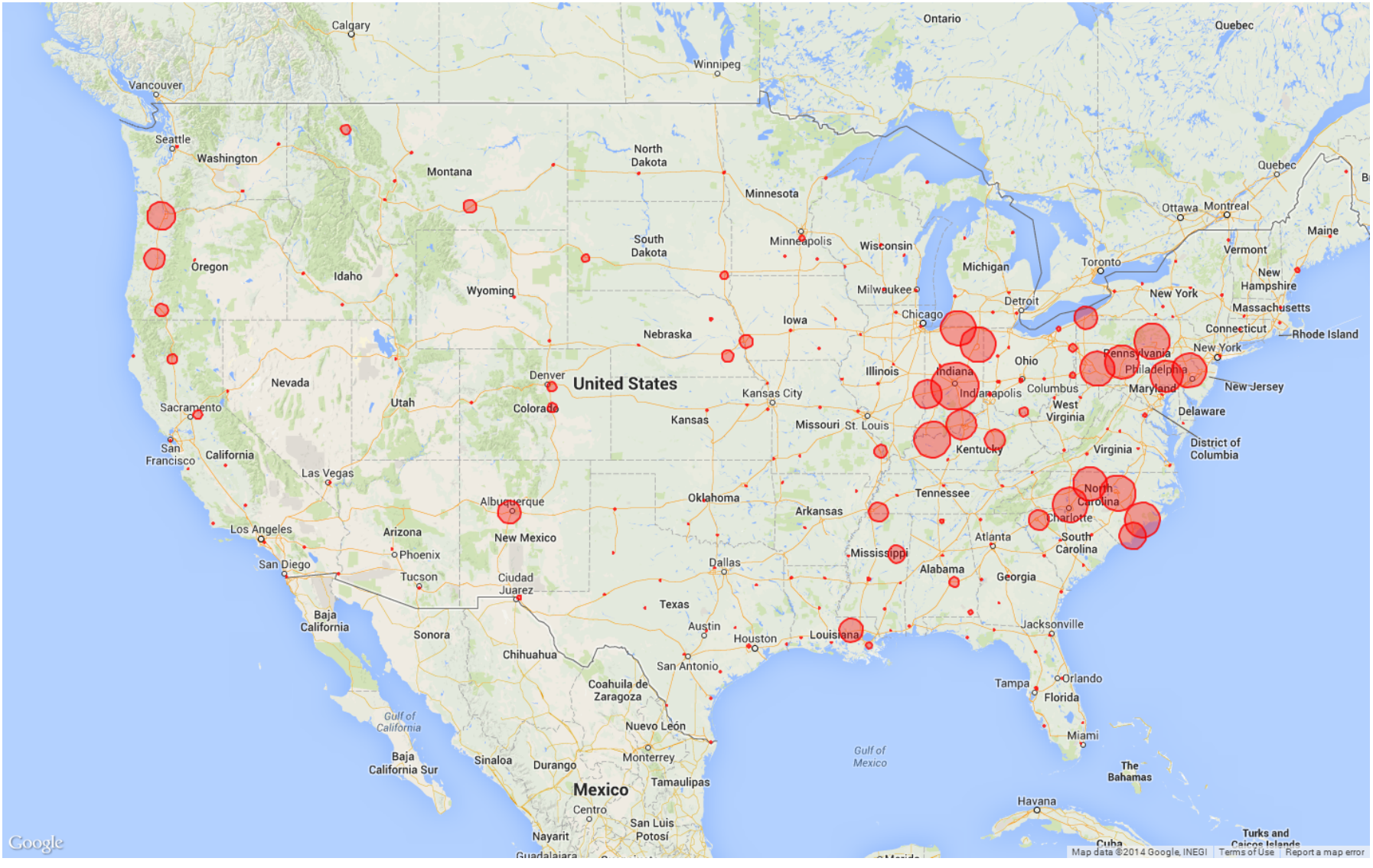
Political Ads, February 2008



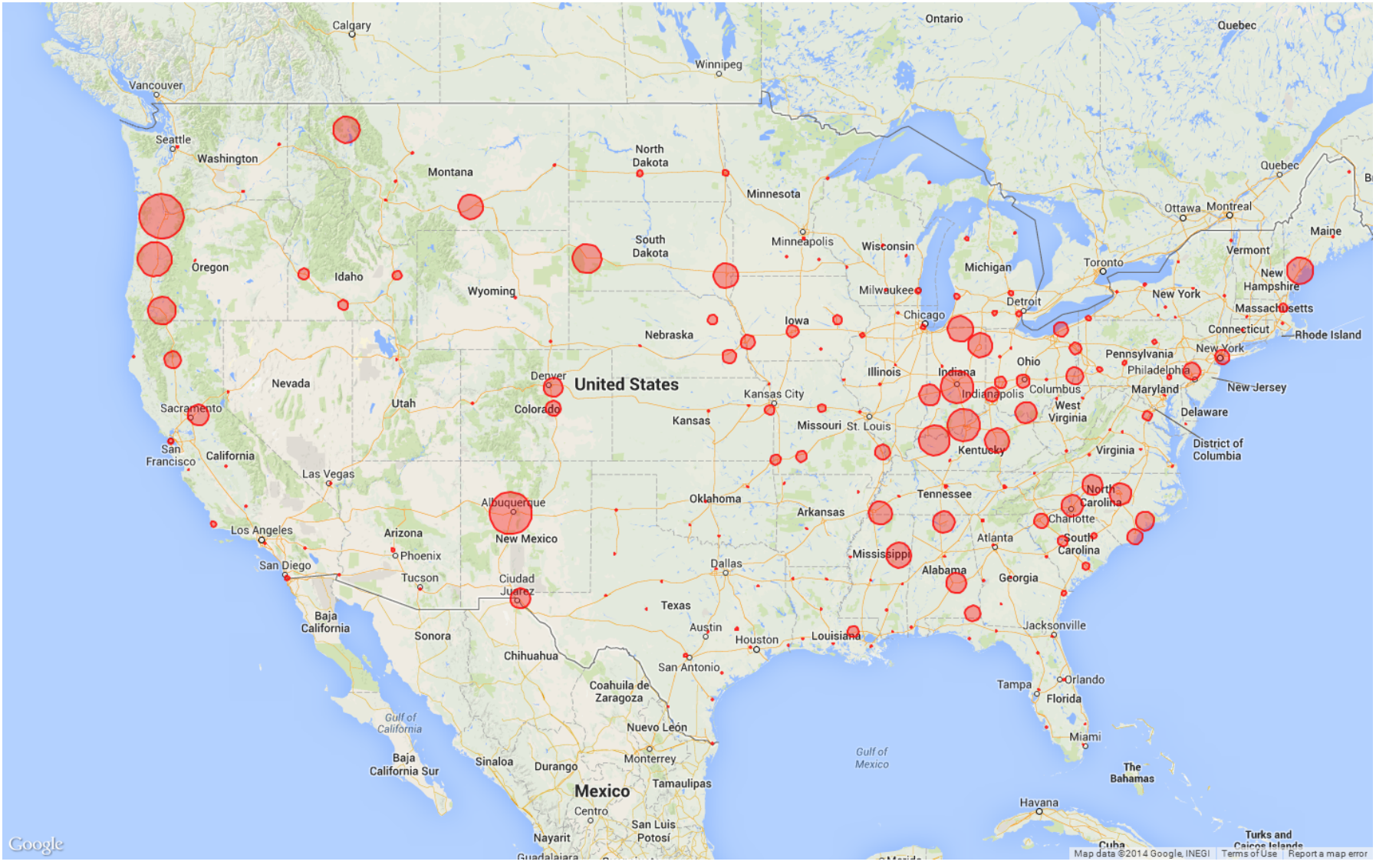
Political Ads, March 2008



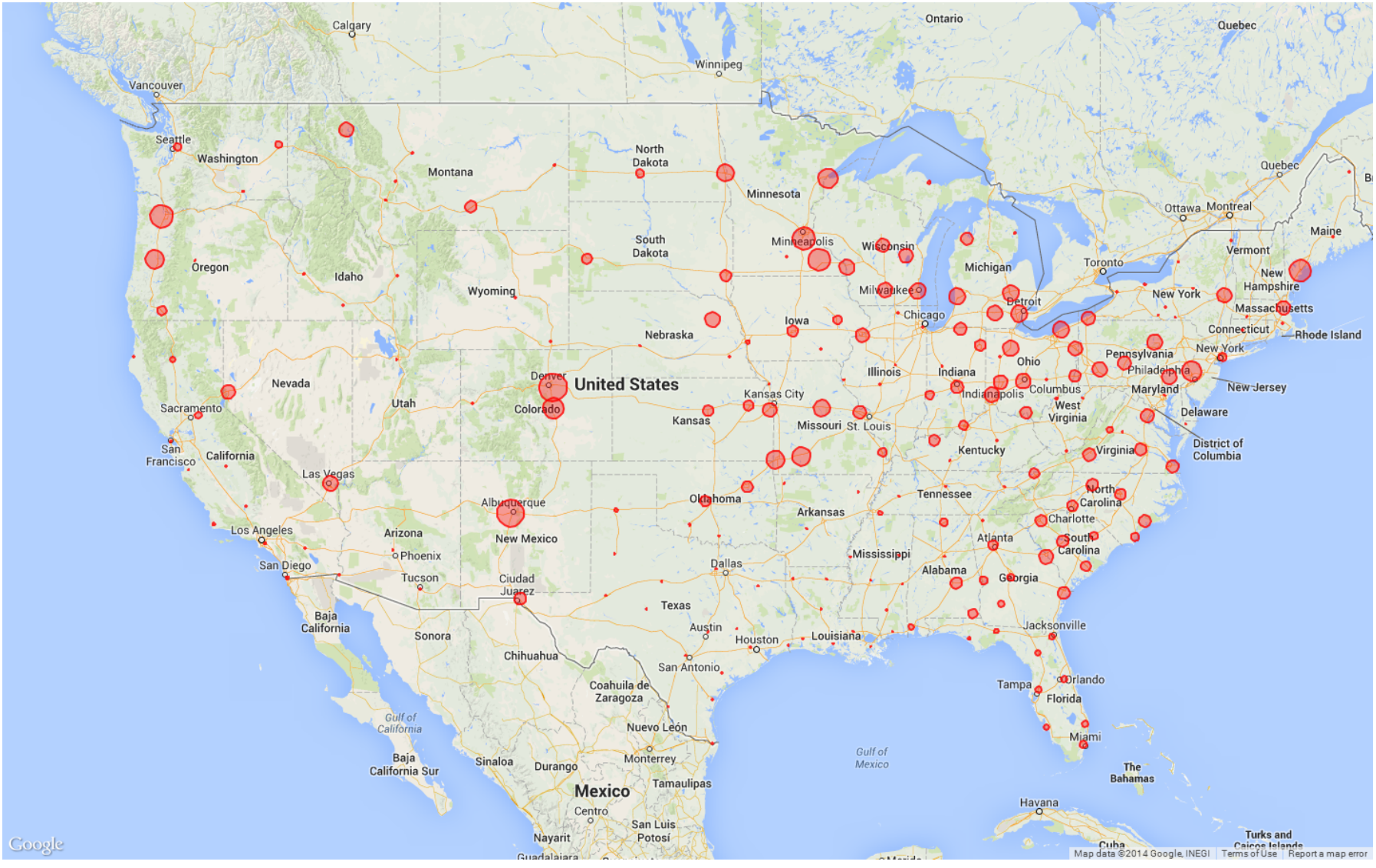
Political Ads, April 2008



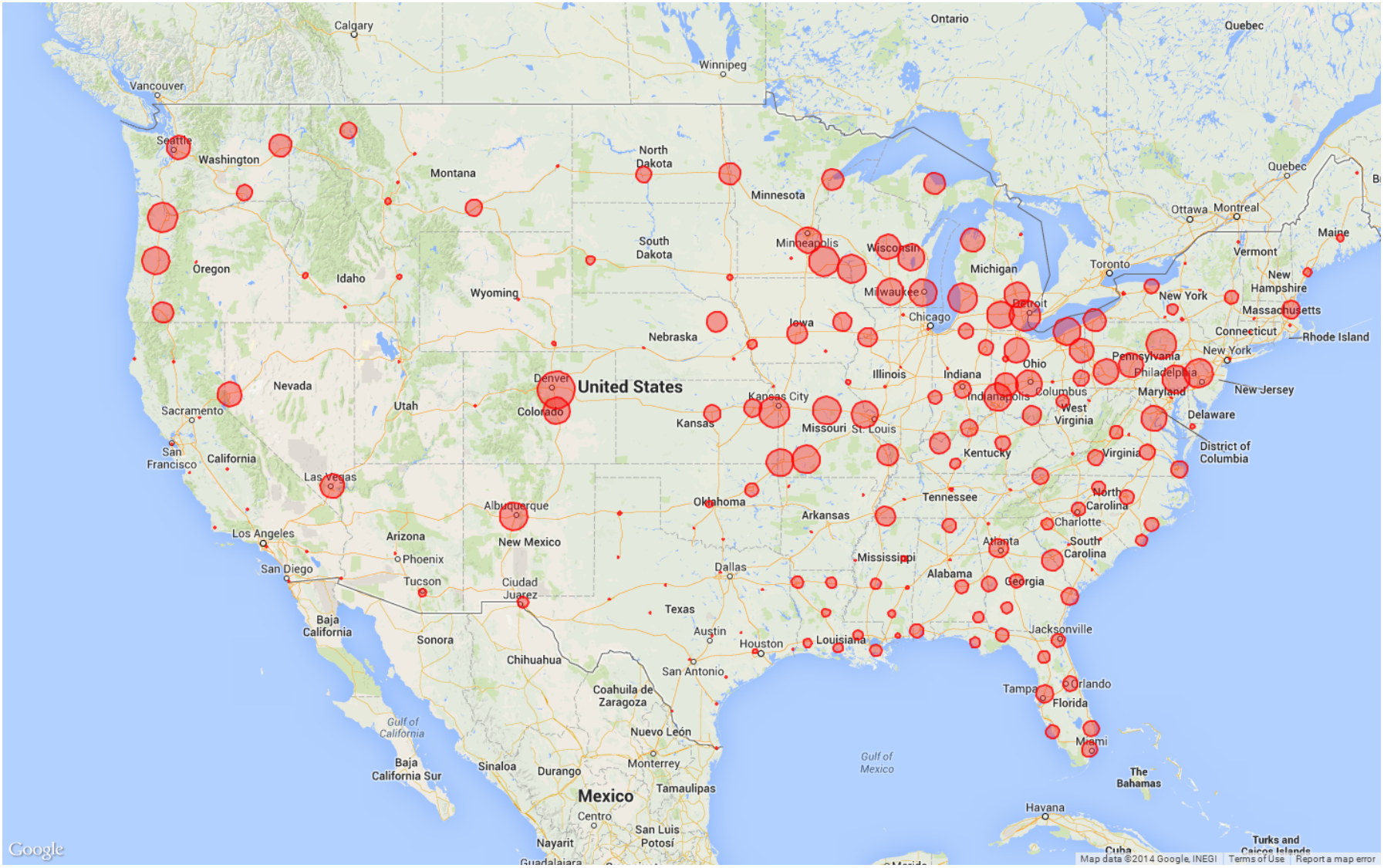
Political Ads, May 2008



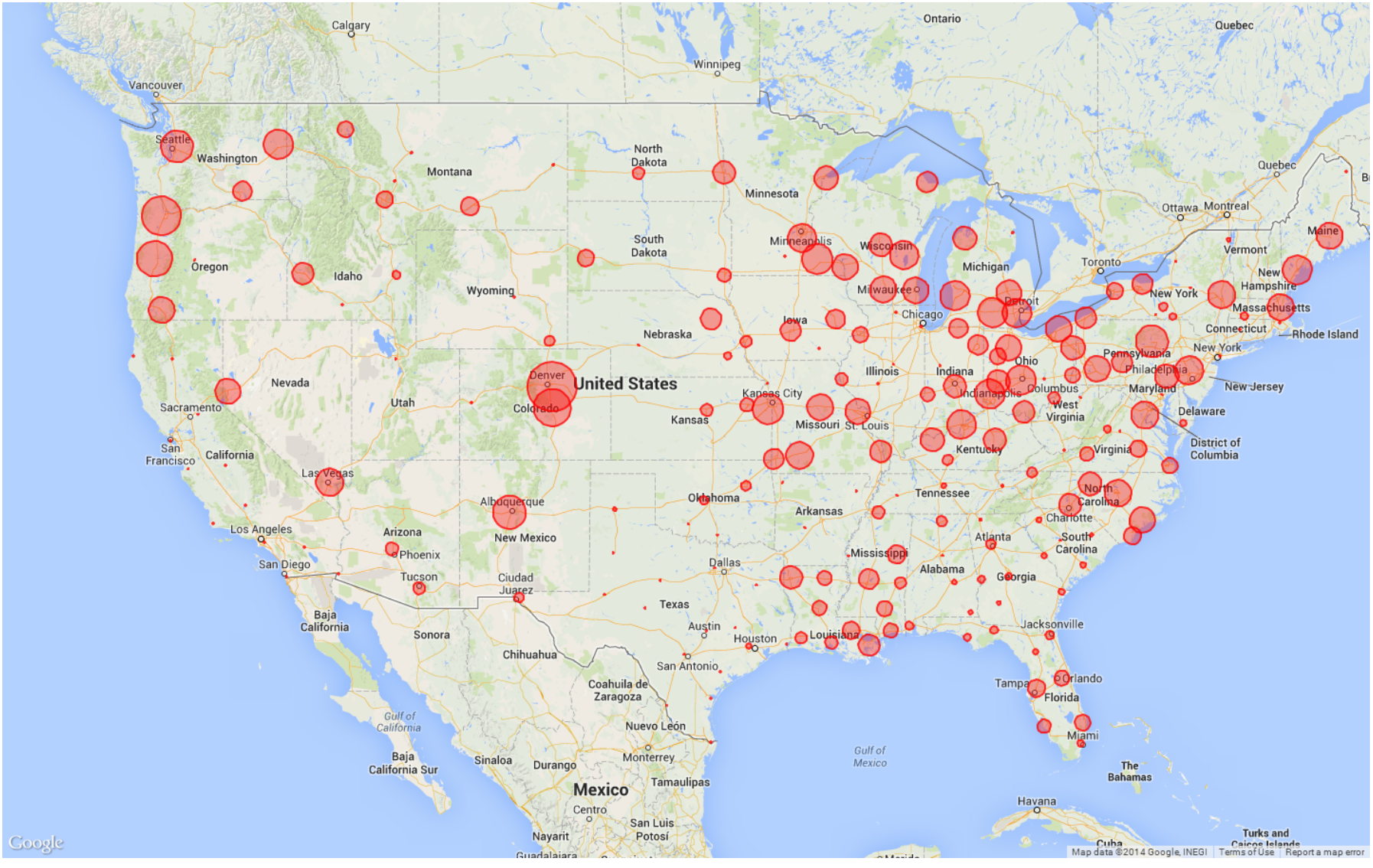
Political Ads, June 2008



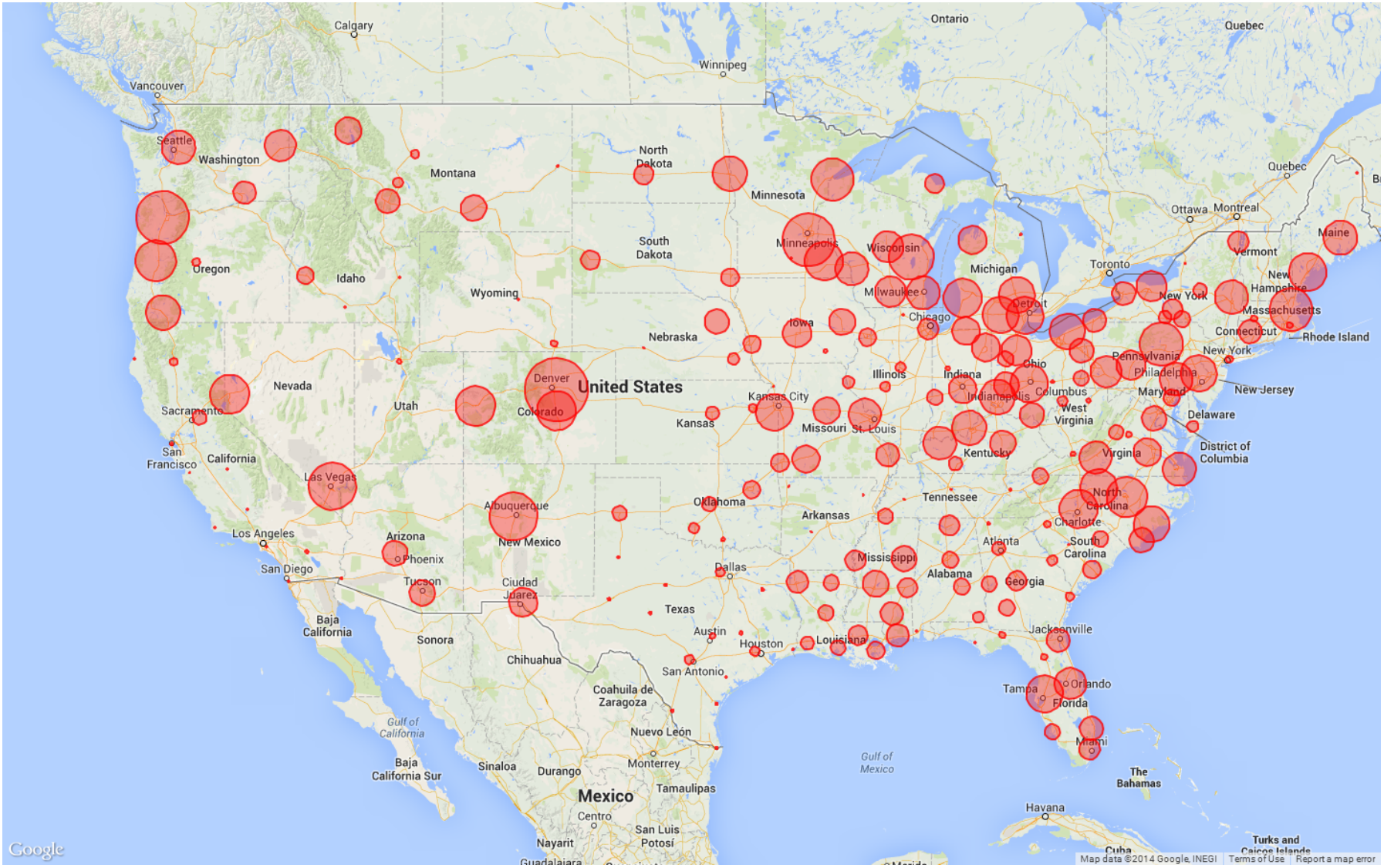
Political Ads, July 2008



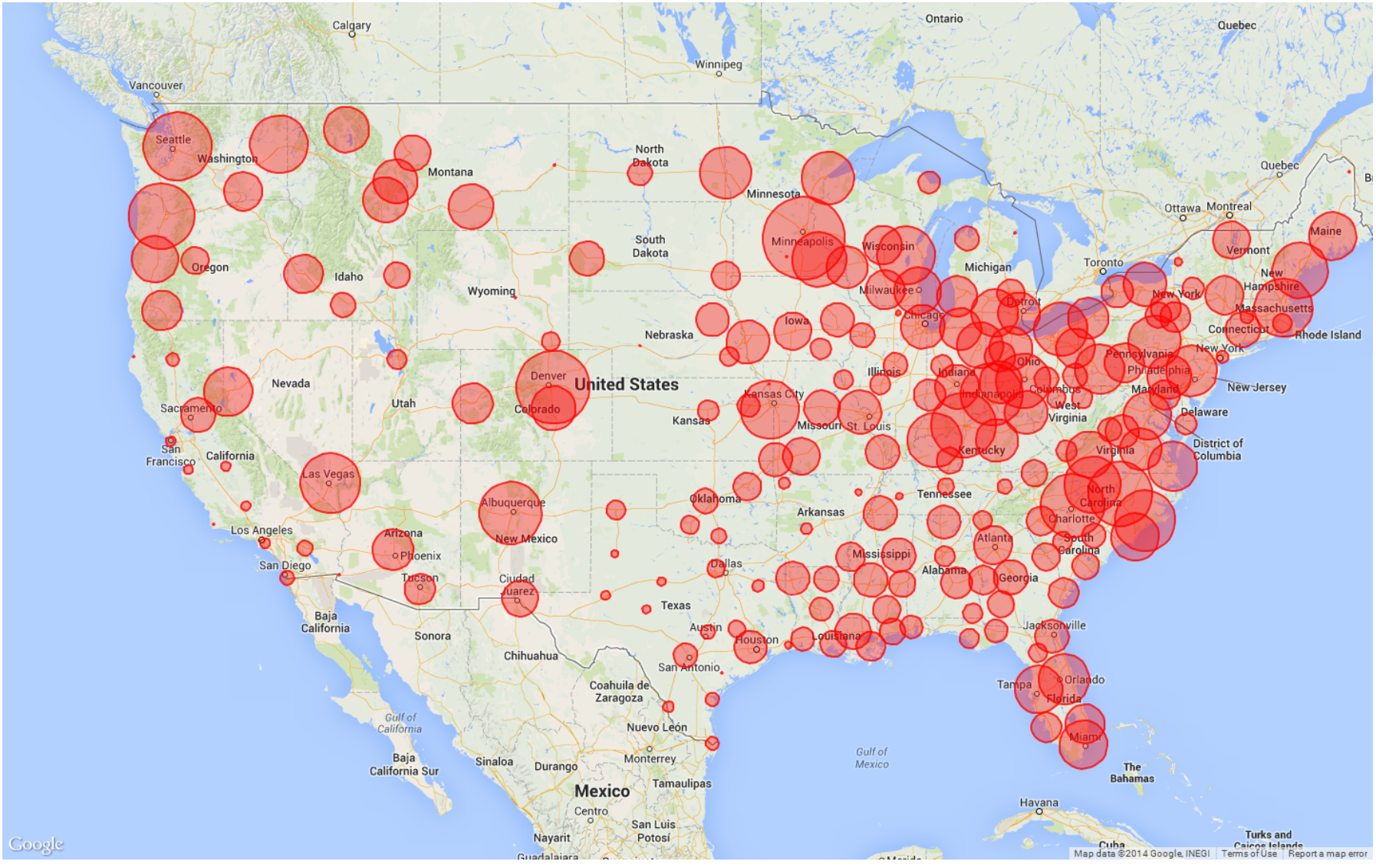
Political Ads, August 2008



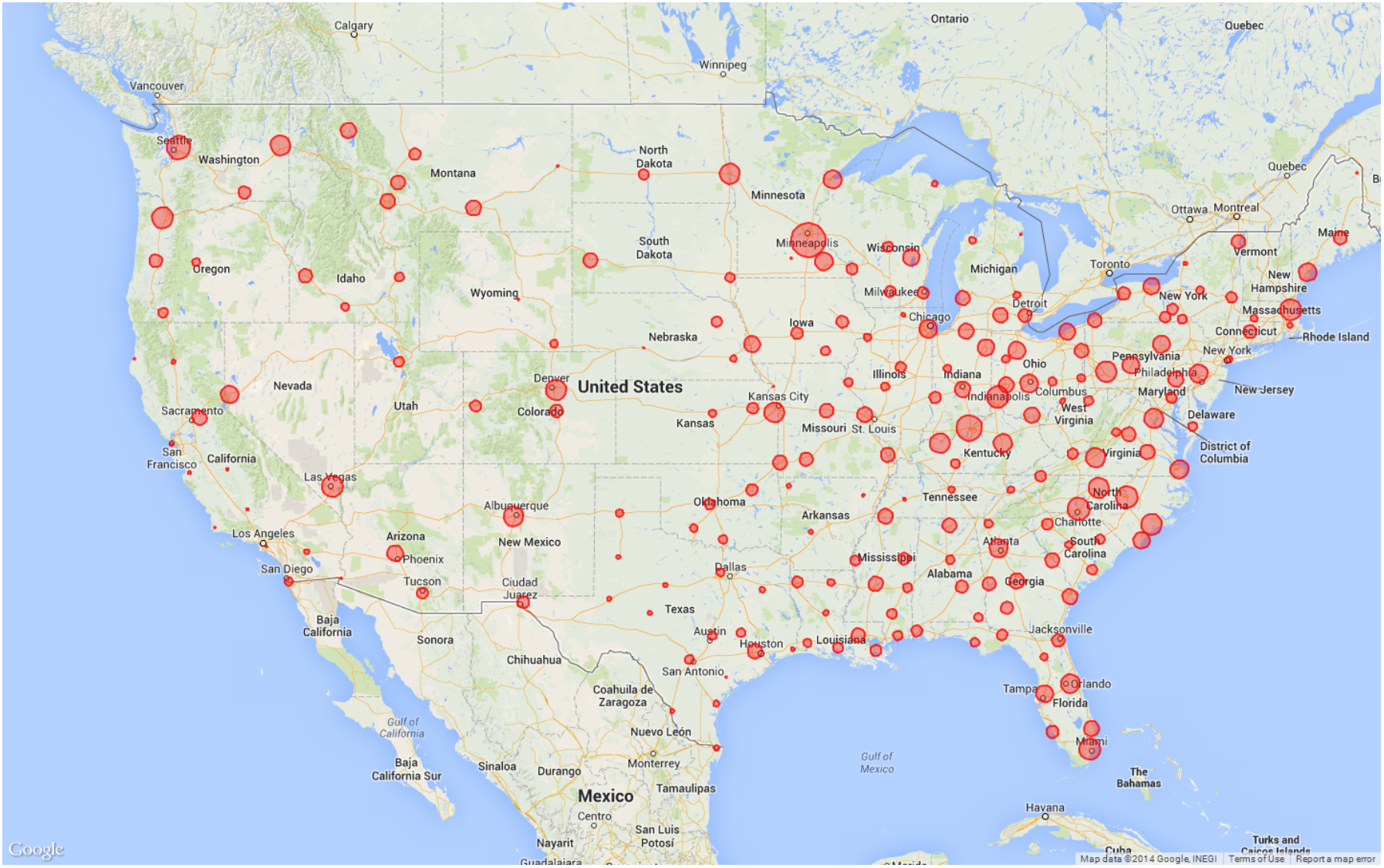
Political Ads, September 2008



Political Ads, October 2008



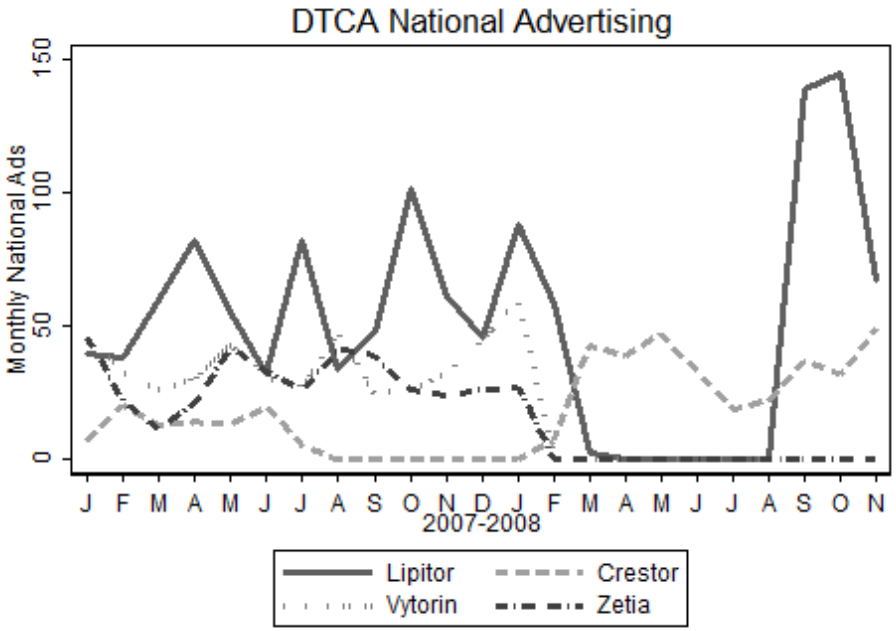
Political Ads, November 2008

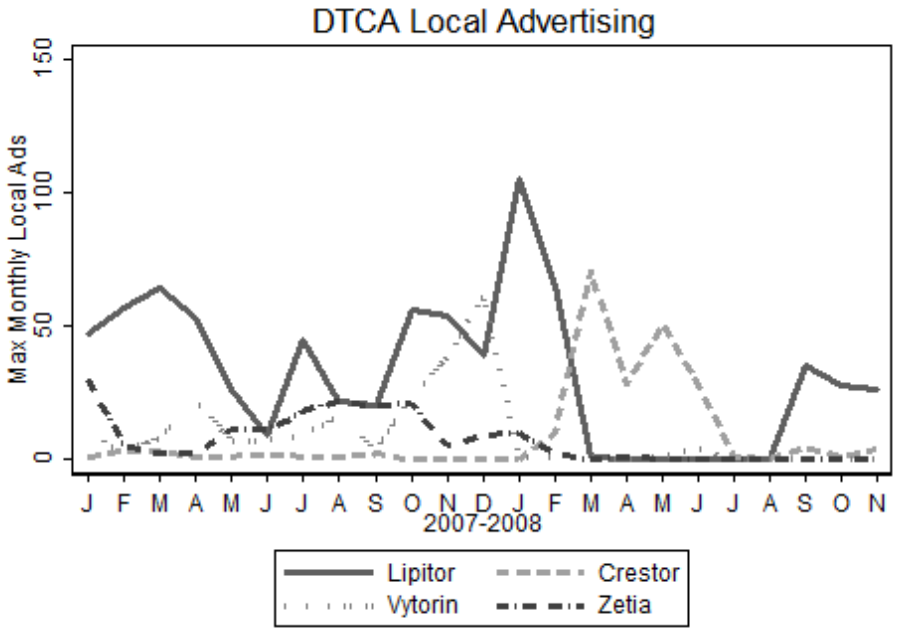


Additional Variation

- We want to predict both firm and industry advertising levels.
- Late February 2008: Congress begins investigating a series of Lipitor ads featuring Dr. Robert Jarvik
- Pfizer halted the ad campaign in April-August 2008
- Political shocks will have differential effects on firms depending on the time period.

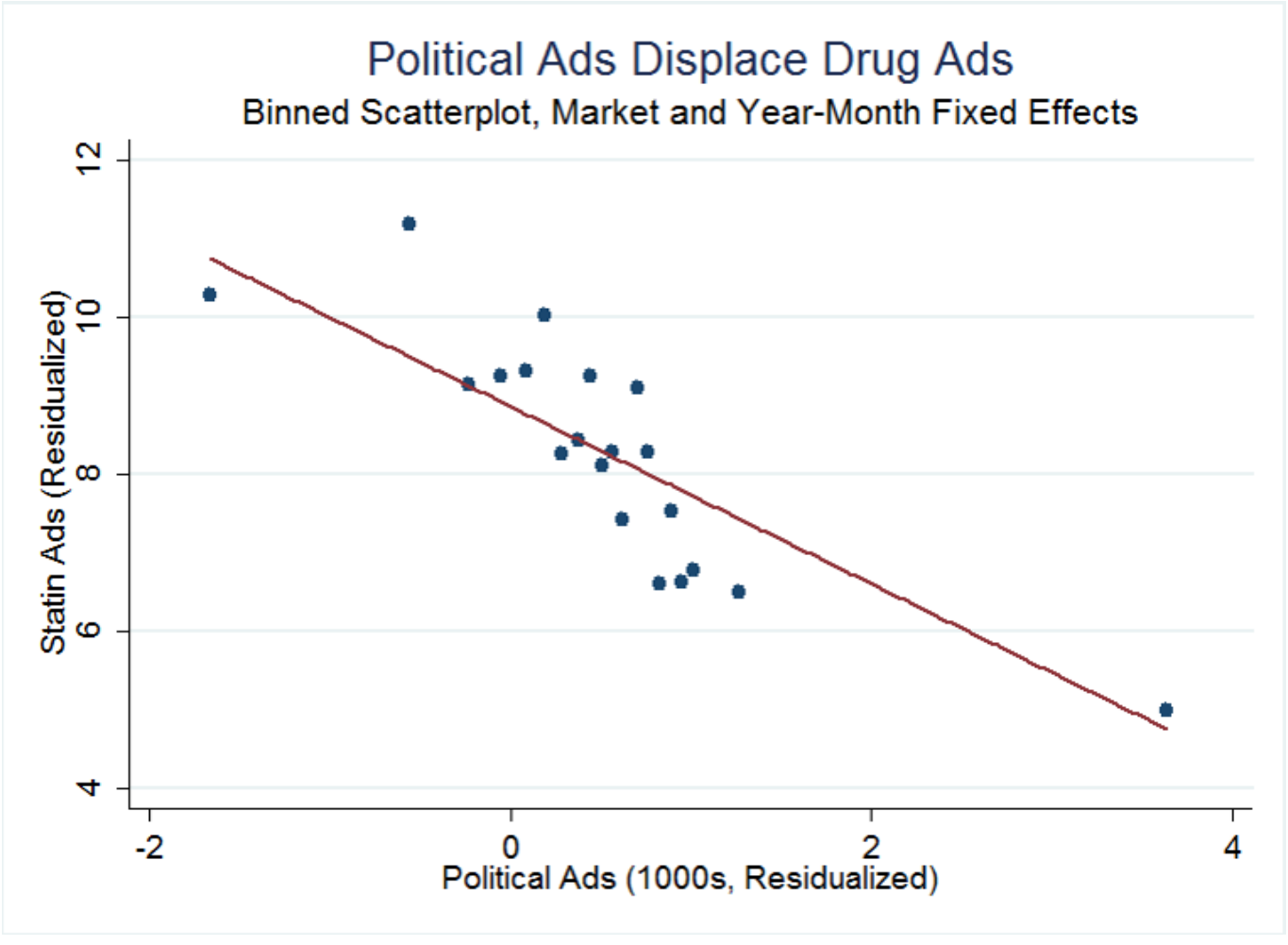
Drug Ads 2007-2008





- Advertising is driven by:
  - Information on effectiveness from clinical trials
  - Competitive interaction
  - Regulation (the case of Lipitor in early 2008)
  - Variation in availability due to political advertising

First Stage


Political Ads Displace Drug Ads
Binned Scatterplot, Market and Year-Month Fixed Effects
Statin Ads (Residualized)
12
10
8
6
4
-2
0
2
4
Political Ads (1000s, Residualized)

First Stage Results

Effect of Political Ads on Statin Drug Ads

Model:	OLS (1)	OLS (2)	OLS (3)	Tobit (4)
Political Ads (1000s)	-0.1895***	-0.1201***	-0.1201***	-0.2598***
	(0.0098)	(0.0116)	(0.0117)	(0.0103)
Controls				
Market FE	X	X	X	X
Year-Month FE		X	X	X
Drug FE	X	X	X	X
Drug-Year-Month FE			X	X
N	24,035	24,035	24,035	24,035
R2	0.314	0.364	0.479	0.552

First Stage Summary

- Specification for main results uses political advertising, a dummy for months affected by Congressional action, their dummies, and higher order terms (quadratic and cubic).
- First stage F-Stats: 318.92 for own ads, 172.00 for rival ads

First Stage Summary

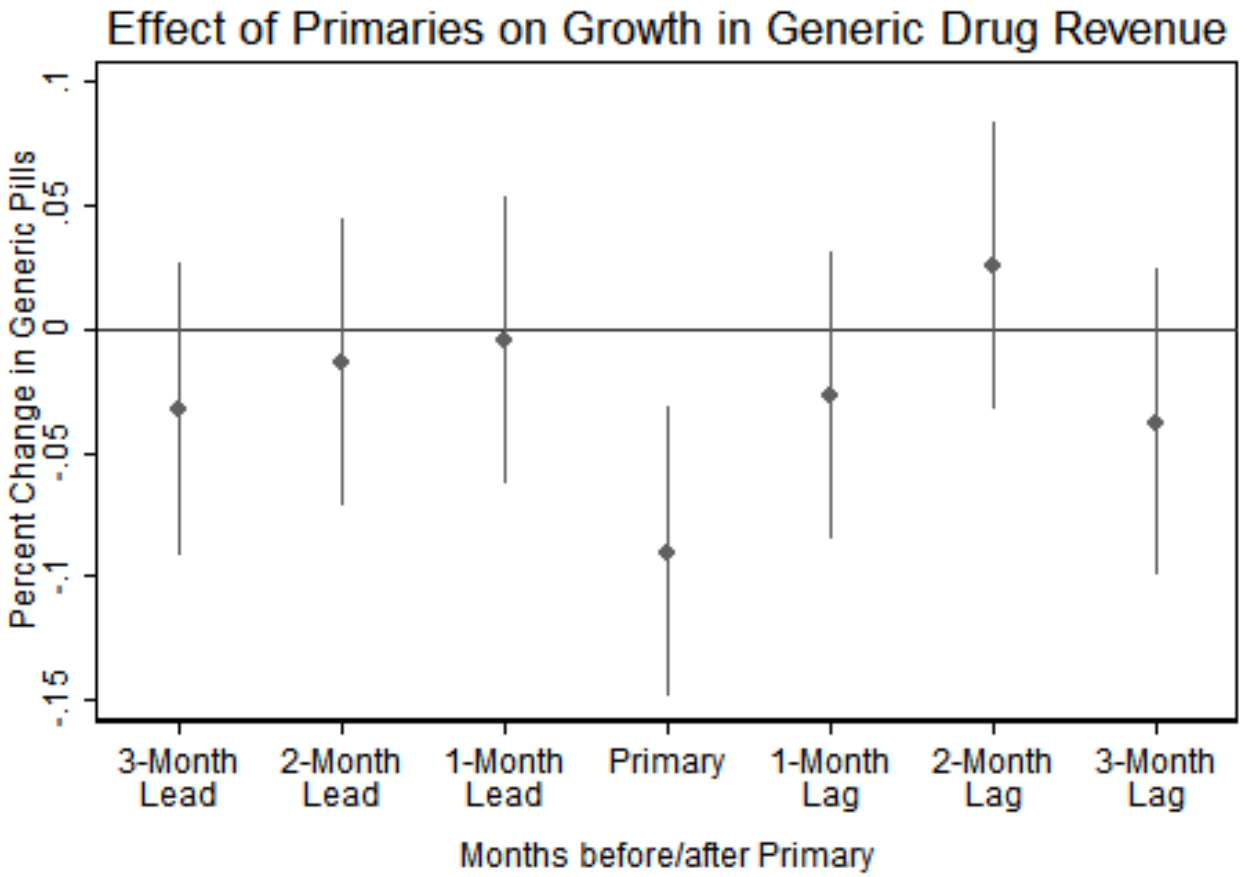
- Specification for main results uses political advertising, a dummy for months affected by Congressional action, their dummies, and higher order terms (quadratic and cubic).
- First stage F-Stats: 318.92 for own ads, 172.00 for rival ads
- No evidence of drug firms shifting ads to months before/after political ad spike
  - Political ads are not predictive of drug ad levels in earlier or later months; one exception is late 2007 Iowa where political ads highly serially correlated.
- No evidence of drug firms shifting ads to other media (radio, newspaper, magazine)
  - Effect of political process felt across all media.
- Unlikely that firms are able to alter physician detailing plans at the monthly level.
  - Discussions with industry sources indicate staffing levels are set annually, would not be feasible to adapt physician detailing to political shocks.

Non-Parametric Effect on Revenues

Effect of Political Ads on Statin Drug Revenue for Advertised Drugs

	(1)	(2)	(3)
1(Any Political Ads)	-0.0403***		-0.0365***
	(0.0057)		(0.0069)
1(Above Median Pol. Ads)		-0.0309***	-0.0079
		(0.0062)	(0.0075)
Controls			
Market FE	X	X	X
Drug-Year FE	X	X	X
N	11,550	11,550	11,550
R2	0.841	0.841	0.841

Non-Parametric Spillovers



▸ Placebo Test

Revenue Results

Dependent variable: Log Drug Revenue per pop

Model:	OLS		IV	
Exposure:	2-Month	3-Month	2-Month	3-Month
Log Own Ads	0.0239***	0.0316***	0.1252***	0.1048***
	(0.0021)	(0.0020)	(0.0136)	(0.0099)
Log Rival Ads	0.0016	0.0008	-0.0966***	-0.0908***
	(0.0027)	(0.0029)	(0.0112)	(0.0095)
Controls				
Market FE	X	X	X	X
Product-Year FE	X	X	X	X
N	11,550	10,875	11,550	10,875

Instruments are a cubic of political advertising, a dummy for months affected by Congressional action, and their interactions. First stage for own ads F-stat 318.92 (2-month), 320.73 (3-month). For rival ads, 172.00 (2-month) and 169.90 (3-month).

Branded vs Generic

Dependent variable: Log Drug Revenue per pop

Model:	OLS		IV	
Products:	Non-Advertised	Advertised	Non-Advertised	Advertised
Log Own Ads	-	0.0239***	-	0.1252***
	-	(0.0021)	-	(0.0136)
Log Rival Ads	0.0018	0.0016	0.0131***	-0.0966***
	(0.0037)	(0.0027)	(0.0044)	(0.0112)
Controls				
Market FE	X	X	X	X
Product-Year FE	X	X	X	X
N	3,146	11,500	3,146	11,500

Ad quantities are two-month trailing averages.

Reduced Form Summary

- Spillovers to generics from branded advertising.
- Large business-stealing effects from rival ads among branded, advertised drugs.
  - Implies that strategic interactions are important in this market.
- Results are robust to alternative specifications ▸ Robustness
  - placebo tests
  - estimate stability
  - regressions of revenue on political ad levels
  - lag structure
  - first stage

Back-of-the-Envelope

- Lipitor spent $175M on advertising in 2009 ($15M/month)
- US revenue was approx. $490M/month
- Pfizer costs were 25% of revenue
- Our elasticity estimates indicate a 1% increase in advertising ($150K) increases profit by 0.125% ($459K)
- Right order of magnitude, but holds rival ads constant

Structural Model: Market Shares

- Two-player game (i.e. Lipitor and Crestor) where firms choose advertising levels each period.
- Transition matrix: every month t, consumers are in a state $j = 0..J$, where $j = 1..J$ represent different drugs and $j = 0$ represents no drug. Consumers evolve each month according to logit probabilities, modeled as a function of advertising levels

$$u_{ijt} = \beta_{0j} + \beta_{1j} log\left(1 + adv_{jt}\right) + \beta_{2j} log\left(1 + adv_{\_jt}\right) + \xi_{jt} + \varepsilon_{ijt}$$

- Outside good (no drug) normalized to zero, but with coefficient on total ads. Allows for market expansion and business stealing effects.
- Estimation via GMM: given a parameter vector, use observed shares to recover ξ_{jt}. Construct moments $E\left[\xi | Z\right] = 0$ for instruments Z, which are political advertising levels.

Structural Model: Advertising Decisions

- Optimal advertising level comes from firm first-order conditions. Define:

$$v_{jt}(\mathbf{s_t}) = max_{a_{j,t} \in [0,\bar{a}]} \{M \cdot \rho \cdot s_{jt} - c_{jt} \cdot a_{jt} + \beta \cdot v_{j,t+1}(f_j(\mathbf{s_t}, \mathbf{a_t}))\}$$

where f represents the share transition process. First order condition:

$$\frac{\partial v_{jt+1}}{\partial a_t} = \frac{c_{jt}}{\beta}$$

- In final period, decision is static: solve for best response functions to rival advertising levels. Intersection of best responses is equilibrium ad level, $\hat{a}$.
- In earlier periods, numerically solve for optimal ad levels.
- Recover "exit value" for each product via minimum distance estimation: $\hat{\theta} = argmin_\theta \Sigma_j \Sigma_t (\hat{a_{jt}} - a_{jt})^2$

Modeling Assumptions

- Allow for persistence in demand and dynamic effect of advertising
- The game if finite
  - Consumers can be characterized by a "scrap" or "exit" value when Lipitor loses patent protection
- Advertising affects profits by increasing quantity leading to patent expiration.

Preliminary Results

Simulation Results: Product Shares with/without Ads

Model:	OLS		IV	
Products	Non-Advertised	Advertised	Non-Advertised	Advertised
Baseline	1.0000	1.0000	1.0000	1.0000
Banning Ads	1.6407	1.4901	0.8157	0.8771

- Simulation of three year period.
- OLS results are nonsensical.
- Ads benefit generics greatly.

Preliminary Results

Simulation Results: Product Shares

Model:	IV	
Products	Non-Advertised	Advertised
Baseline	1.0000	1.0000
Banning Ads	0.8157	0.8771
Eliminate Rival Responses	0.9279	0.8326

Simulation Results: Ad Levels

Ad Levels	Non-Advertised	Advertised
Baseline	-	1.0000
Eliminate Rival Responses	-	0.4242

Conclusions

- Preliminary conclusions: Significant portion of ads are "defensive" or "business-stealing"; rational for firms but potentially not beneficial to market.
- Ads have strong positive spillovers to generics, suggesting positive welfare effect and potential policy recommendations.
- Future counterfactuals:
  - Solve for optimal policies in the absense of political ads
  - Introduce PSA-style ads for generics (post-patent)
  - Extend patent life

Implications for Measurement

The true relationship is:

$$E(Y|1, X_j, X_{-j}) = \beta_0 + \beta_1 X_j + \beta_2 X_{-j}$$

Assume the relationship between my ads and rival ads is given by:

$$E(X_{-j}|1, X_j) = \gamma_0 + \gamma_1 X_j$$

If I do not include the effect of my rivals, I will estimate:

$$E^*(Y|1, X_j) = (\beta_0 + \beta_2 \gamma_0) + (\beta_1 + \beta_2 \gamma_1) X_j$$

Under strategic complements and business stealing, the presence of competitive effects will bias the effect of advertising downward. Return

Implications for Measurement

The true relationship is:

$$E(Y|1, X_j, X_{-j}) = \beta_0 + \beta_1 X_j + \beta_2 X_{-j} + \beta_3 \xi$$

Assume the relationship between the market or product level shock, my ads and rival ads is given by:

$$E(\xi|1, X_j, X_{-j}) = \gamma_0 + \gamma_1 X_j + \gamma_2 X_{-j}$$

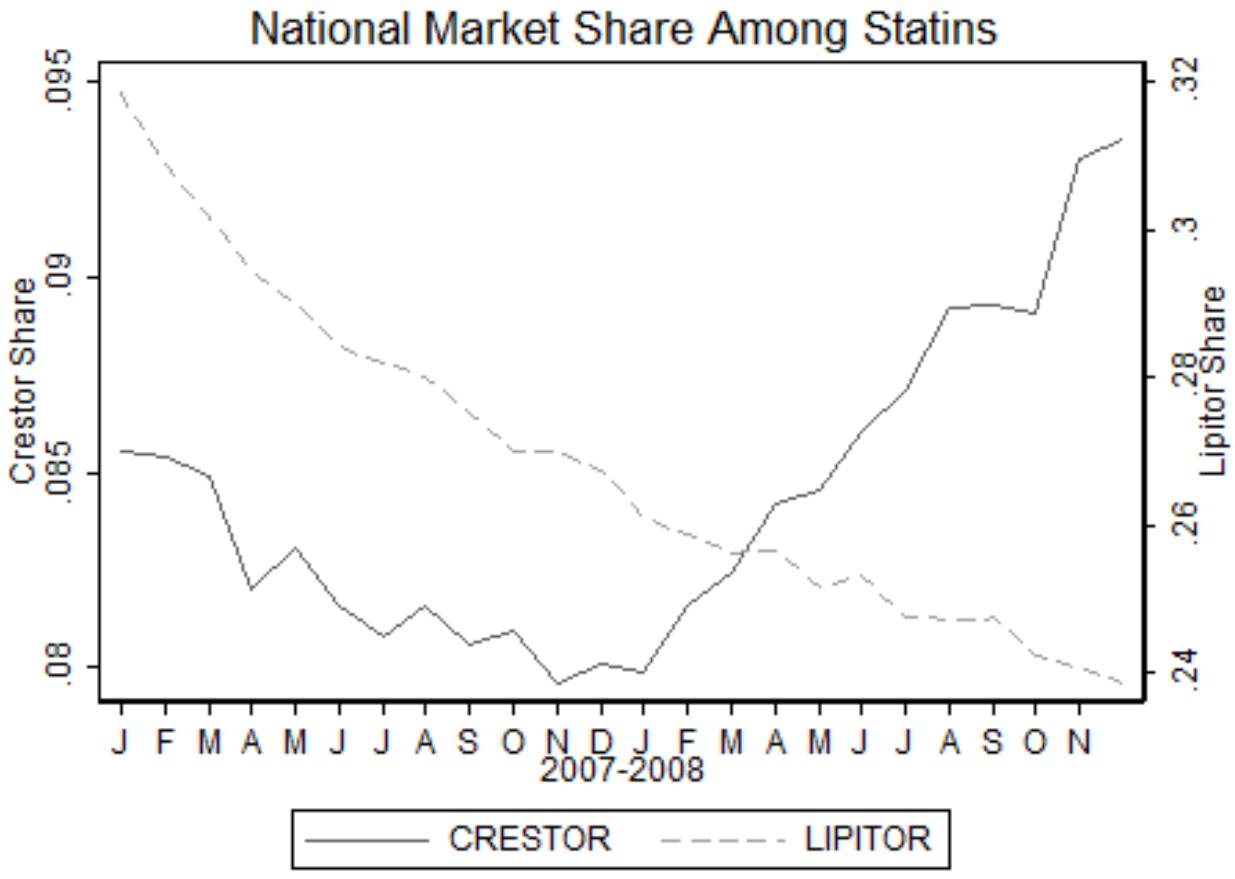
If I do not include the effect of my rivals, I will estimate:

$$E^*(Y|1, X_j, X_{-j}) = (\beta_0 + \beta_3 \gamma_0) + (\beta_1 + \beta_3 \gamma_1) X_j + (\beta_2 + \beta_3 \gamma_2) X_{-j}$$

The bias depends on:

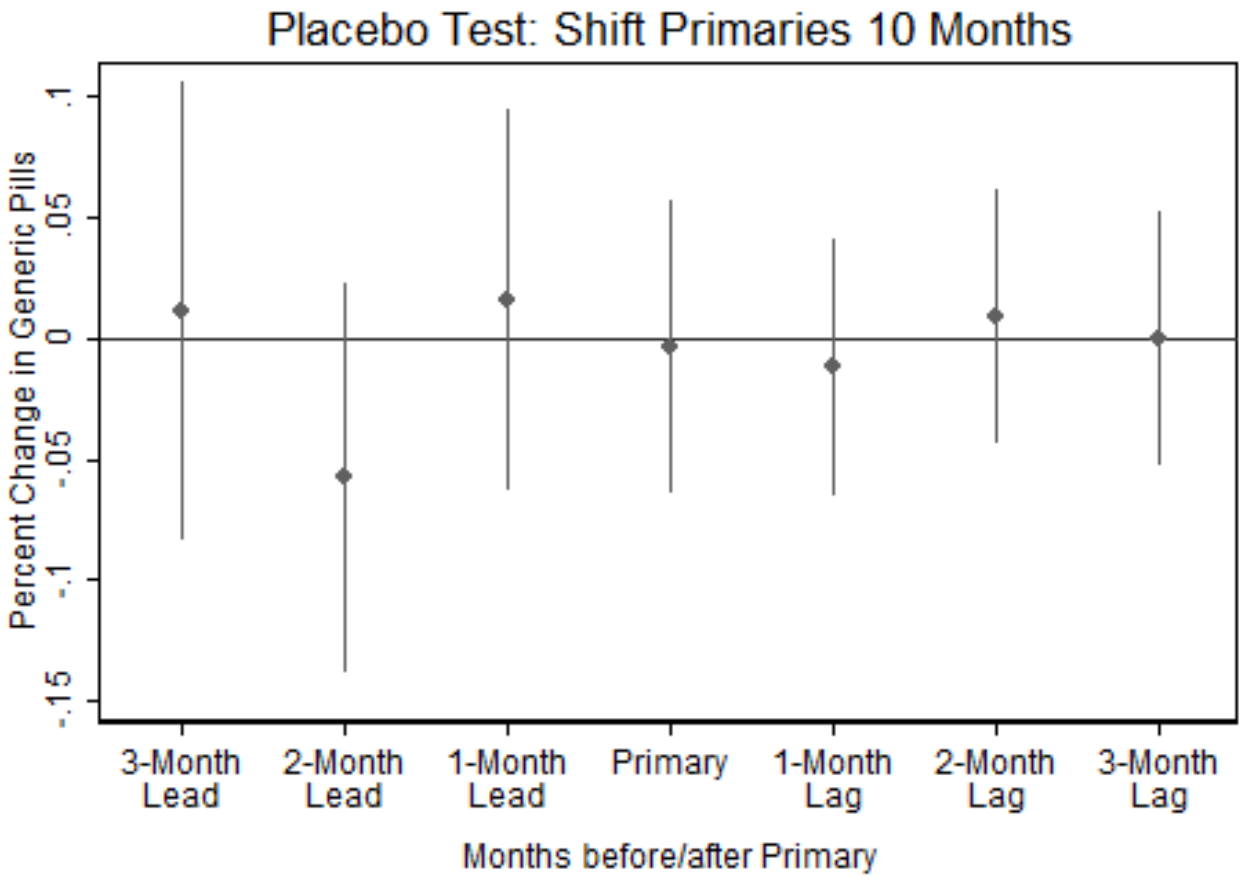
- how firms advertise in response to a positive demand shock (more advertising or less)
- stategic interaction between firms, especially if the shock is market wide

Drug Shares 2007-2008



- Advertising may impact sales, but we want to identify the causal effect.Placebo Test

Placebo Test



Back

Business Stealing

Dependent variable: Log Drug Revenue per pop

Exposure:	2-Month		3-Month	
Log Own Ads	0.0163***	0.1252***	0.0198***	0.1048***
	(0.0030)	(0.0136)	(0.0028)	(0.0099)
Log Rival Ads		-0.0966***		-0.0908***
		(0.0112)		(0.0095)
Controls				
Market FE	X	X	X	X
Product-Year FE	X	X	X	X
N	11,550	11,550	10,875	10,875

Back