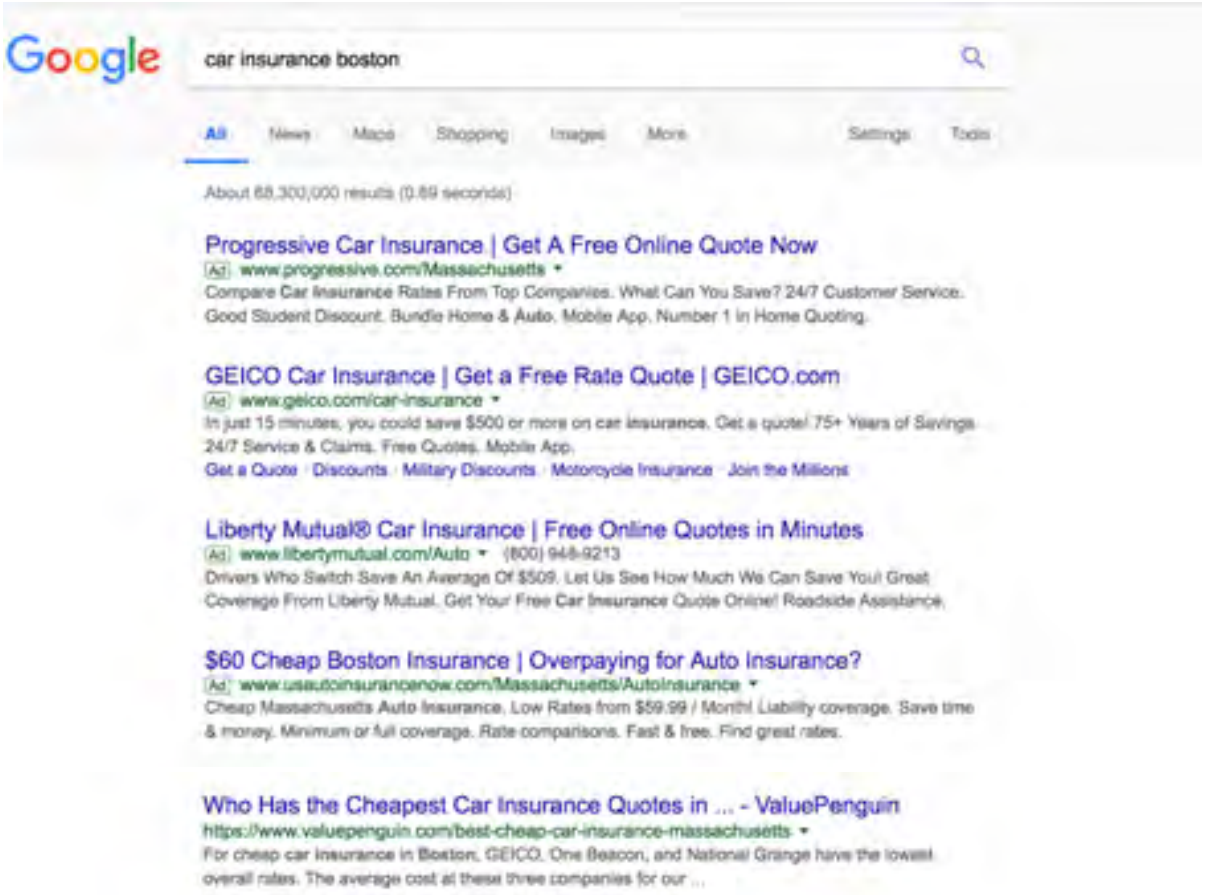
From Mad Men to Maths Men: Concentration and Buyer Power in Online Advertising

Francesco Decarolis (Bocconi University) Gabriele Rovigatti (Bank of Italy)

Internet Advertising and Sponsored Search

- Internet advertising revenues in US: $57.9 billion HY 2019
- Revenues for HY 2019 increased 16.9% over HY 2018
- Main segment: Sponsored search (46%), then banner (31%)



Sponsored Search and Marketing Agencies

Highly **concentrated supply**: Google's revenues range between 75% and 80% of total

Traditional view of the other players in sponsored search:

1) **Consumers:**
   - Search for products/services: known or new (learning)
   - Shop for product/services: ubiquitous online buy options
2) **Advertisers:**
   - Seek attention of relevant consumers: targeting
   - Have complex, sometimes conflictual interactions with search engines

Sponsored Search and Marketing Agencies

Highly **concentrated supply**: Google's revenues range between 75% and 80% of total

Traditional view of the other players in sponsored search:

1) **Consumers:**
   - Search for products/services: known or new (learning)
   - Shop for product/services: ubiquitous online buy options
2) **Advertisers:**
   - Seek attention of relevant consumers: targeting
   - Have complex, sometimes conflictual interactions with search engines
3) **Intermediaries - Digital Marketing Agencies (DMAs):**
   - Modern version of the traditional "Madison Avenue" agencies
   - At least since 2011, delegation of bidding to DMAs, who further delegate to their agency network's centralized Agency Trading Desk (ATD)

Intermediated Bidding and Demand Concentration

The demand side has vastly changed thanks to intermediaries:

- **Technological innovations**: automated bidding systems to address the need for more speed (high frequency or even real-time) and better data usage
- **Growing concentration**: 7 large ATDs, active at the agency network level ▸ ATD list

	Search Volume Share				Presence across Keywords			
	2014	2015	2016	2017	2014	2015	2016	2017
IPG	0.21	0.19	0.21	0.19	0.26	0.32	0.33	0.38
WPP	0.17	0.20	0.16	0.23	0.29	0.29	0.33	0.43
Omnicom	0.17	0.16	0.17	0.14	0.39	0.38	0.37	0.38
Publicis	0.14	0.13	0.13	0.18	0.30	0.30	0.29	0.30
MDC	0.09	0.09	0.08	0.09	0.17	0.17	0.17	0.24
Havas	0.05	0.07	0.06	0.02	0.12	0.14	0.12	0.06
Dentsu-Aegis	0.05	0.08	0.10	0.09	0.14	0.17	0.19	0.25
Indep Age	0.13	0.09	0.08	0.06	0.42	0.38	0.35	0.22

Motivation and Findings

Intermediaries can significantly impact the marketplaces with effects that are both positive (more bidders/keywords) and negative (coordinated bids) for search engines' revenues

We use new, extensive data on both keyword bidding (40 million keyword **auctions**) and links advertisers-DMAs-ATDs (all DMAs and ATDs of 6,000 large advertisers) to quantify how increases in intermediaries' concentration affect Google's sponsored search revenues

Using an IV strategy, we find a sizeable, negative relationship between Google's revenues and buyers' HHI (an HHI increase of 245.1 points - the average rise in concentration associated with intermediaries? M&As - leads to an 11.32% drop in Google's revenues)

Implies that countervailing power can play a key role in disciplining market power in online platform markets, opening the door to questions about whether this approach might be preferable to public regulation

Related Literature and Contributions

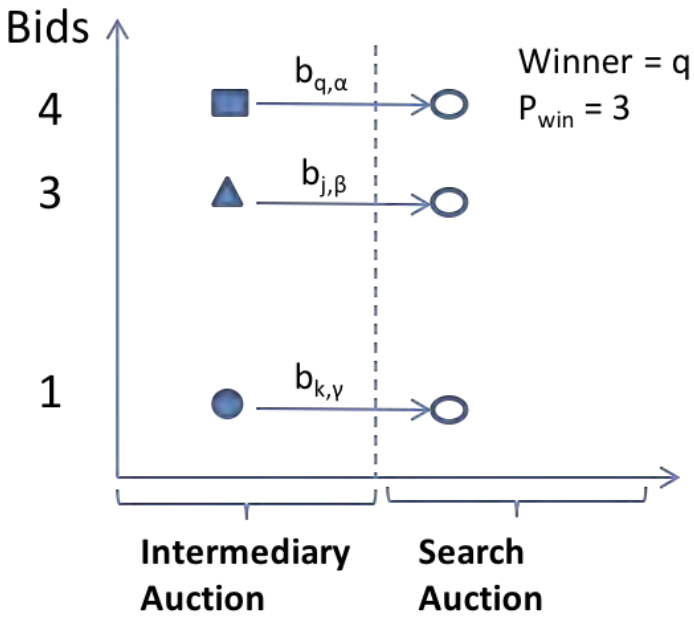
- **Market concentration, superstar firms, and buyer power** (Academics: [Autor et al., 2017; De Loecker and Eeckhout, 2020; Gutierrez and Philippon, 2017], Press: [Economist, 2016; Stiglitz, 2016], Policy: [Mullan and Timan, 2018]) $\Rightarrow$ countervailing buyer power [Galbraith, 1952];
- **Online markets, ad space sales and intermediaries**: [Edelman, Ostrovsky and Schwarz, 2007; Varian, 2007; Athey and Nekipelov, 2014], [Bergemann and Bonatti, 2011], [McAfee, 2011]) $\Rightarrow$ Role of intermediaries and information sharing in improving outcomes;
- **Collusion in auctions and algorithmic pricing** (General: [Graham and Marshall, 1987; Hendricks, Porter and Tan, 2008], Online: [Mansour, Muthukrishnan and Nisan, 2012; Decarolis, Goldmanis and Penta, 2019], AI pricing: [OECD, 2017; Calvano et al., 2018]) $\Rightarrow$ Role of the "coordinated bidding" in driving industry dynamics, and the role of Agency Trading Desks;
- **Industry definition** (Antitrust: [DOJ merger guidelines, EC merger regulation], Natural Processing Language: [Pennington, Socher and Manning, 2014]) $\Rightarrow$ Machine learning for industry definition.

Outline

Theoretical Example

- Suppose there is a monopolist search engine selling 1 ad slot
- There are three advertisers (q, j, k) interested in the slot
- They have arbitrary bids: $b_q = 4$, $b_j = 3$ and $b_k = 1$
- They must bid through an intermediary (α, β or γ)
- 2-level Second Price Auction system

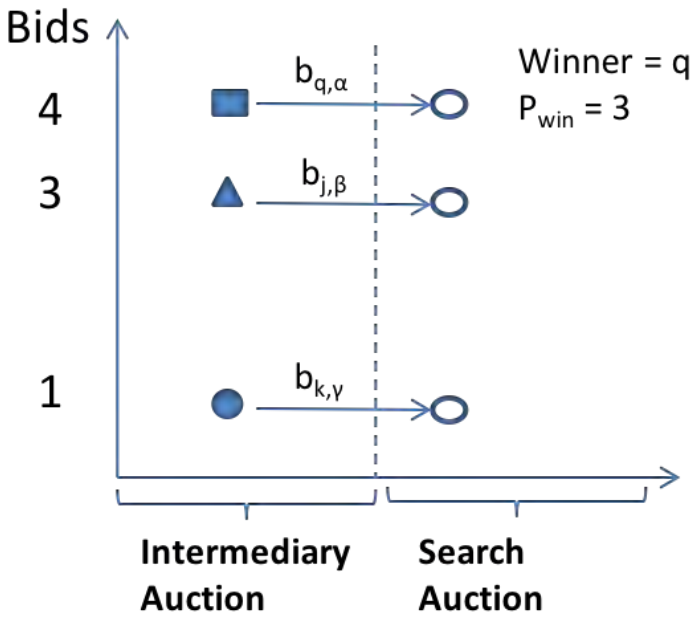
Panel A: 3 Advertisers, 3 Intermediaries



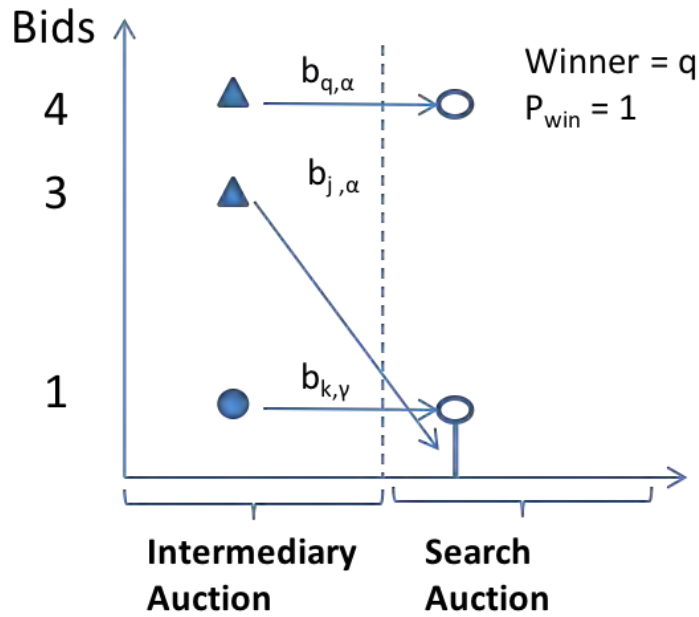
Theoretical Example

- Suppose there is a monopolist search engine selling 1 ad slot
- There are three advertisers (q, j, k) interested in the slot
- They have arbitrary bids: $b_q = 4$, $b_j = 3$ and $b_k = 1$
- They must bid through an intermediary (α, β or γ)
- 2-level Second Price Auction system

Panel A: 3 Advertisers, 3 Intermediaries



Panel B: 3 Advertisers, 2 Intermediaries



Generalization of the Example

Same logic applies more broadly:

- Bidding with multiple slots (GSP): ▸ DGP (2020)
- Market segmentation: via targeting or across keywords

Implication: ↑ intermediaries' concentration, ↓ SE revenues

But **potential efficiencies** driven by coordinated actions:

- Externalities [Jeziorski and Segal, 2015]
- Winners' curse [McAfee, 2011]
- Budget constraints [Balseiro and Candogan, 2017]

Overall: ↑ intermediaries' concentration, ↑ ? ↓ SE revenues

Aside: is bidding coordination proper?

Yes: intermediaries are entities, independent from advertisers, that operate unilaterally to maximize their profits and, as such, they can freely decide how to arrange bidding on behalf of their customers.

But three caveats:

- **Common bidding agents**: only in some contexts are per se illegal (e.g., U.S. Department of Agriculture, see Coatney, 2014); other cases evaluated under a "rule of reason"
- **Purchasing Agreements/Group Purchasing Organizations** (Elhauge, 2003): anticompetitive effects when they foreclose enough of the market to impair rivals' efficiency
- **Hub and spoke cartels** (Harrington, 2018): advertisers hire a common intermediary with the explicit intent to collude

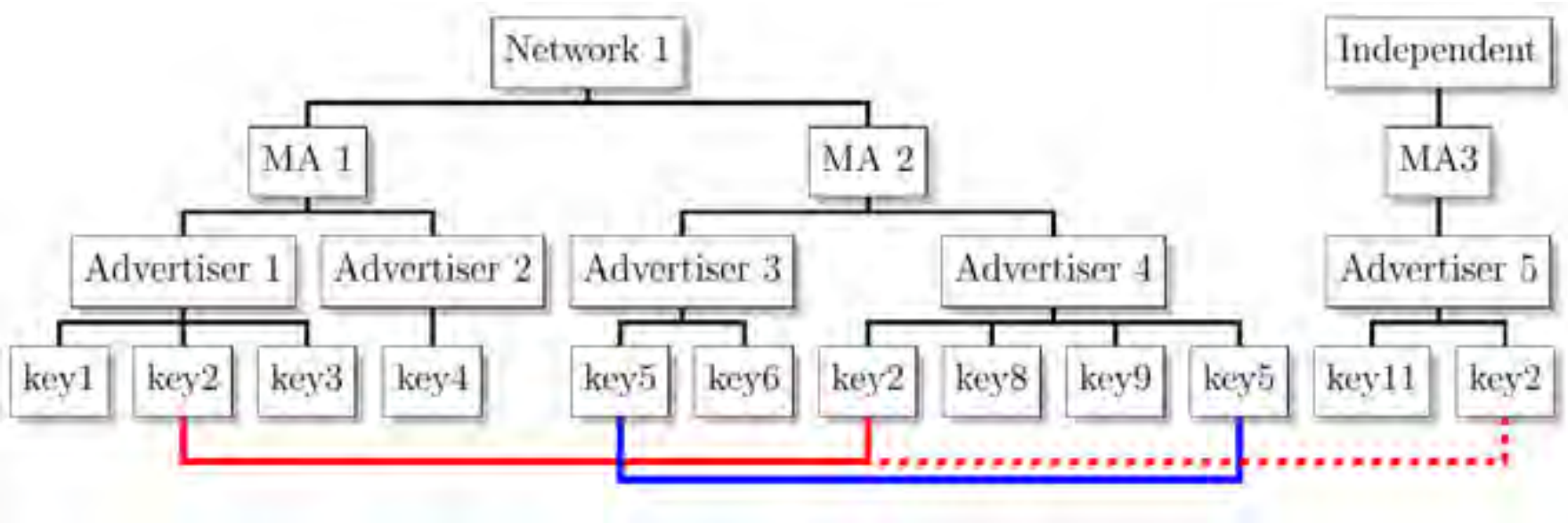
Outline

Data

- *Redbooks:*
  - Data on links advertisers-to-agencies
  - Yearly data 2011-2017 covering around 6,000 advertisers (i.e., web domains) per year active in all sectors ▸ advertisers
    - US: 4,400 publicly traded companies, plus largest private
    - Non US: top 2,000 global companies
  - For 2014-2017, link agencies to networks (ATD) ▸ networks

- *SEMrush:*
  - Data on links keywords-advertisers (URLs)
  - Google data on both paid and organic search
  - Up to the 50,000 most important keywords bid for each advertiser 2012 - 2017 (January), but with possibility to use higher frequency data (monthly/daily)
  - Keyword level: data on CPC, search volume, competition
  - Keyword/advertiser level: position, previous position, traffic

Data Structure



Data structure: keywords (SEMrush), advertisers (Redbooks/SEMrush), agencies and networks (Redbooks). Solid lines represent examples of coalitions: within DMA (blue) and network (red).

The relevant intermediary level is the **agency network** (in the example, Advertisers 1, 2, 3 and 4 are together under Network 1) ▸ descriptives

Example of Data and Coalition

Case Study - DD

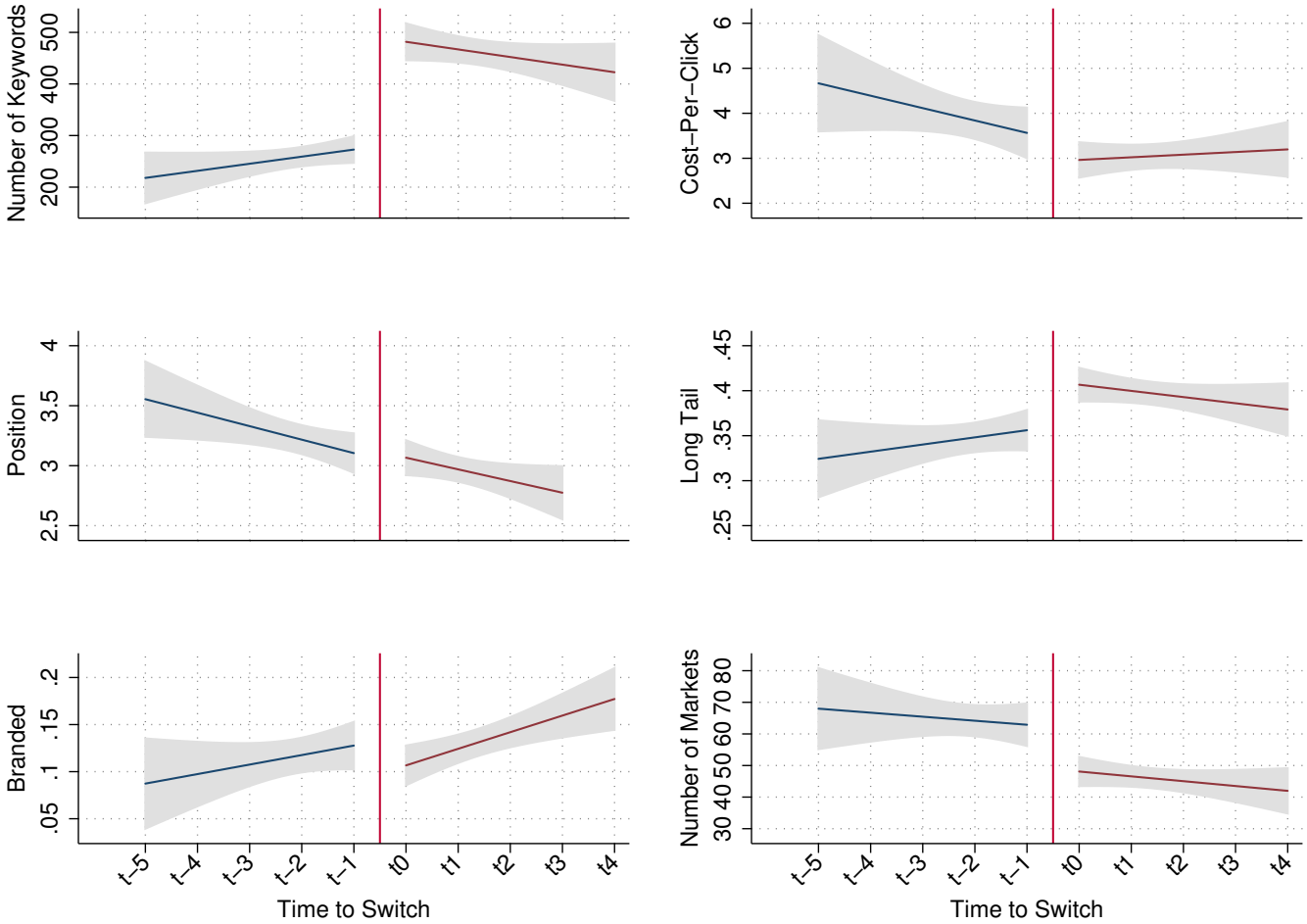
Merkle: large DMA with multiple clients (Redbooks data) active on the same keywords (SEM Rush data)

Example from charity sector: *Habitat for Humanitas* and *Salvation Army*

Keyword	CPC ($)	Volume (mil)	Position	
			Habitat	*Salv.Army*
habitat for humanity donations pick up	4.01	40	1	4
charities to donate furniture	1.08	20	3	9
donate online charity	0.93	20	11	10
website for charity donations	0.90	19	11	6
salvation army disaster relief fund	0.03	20	2	1

In July 2016, Merkle acquired by Dentsu-Aegis for $1.5 billion dollars. Change in concentration in many markets with Merkle/Dentsu-Aegis advertisers

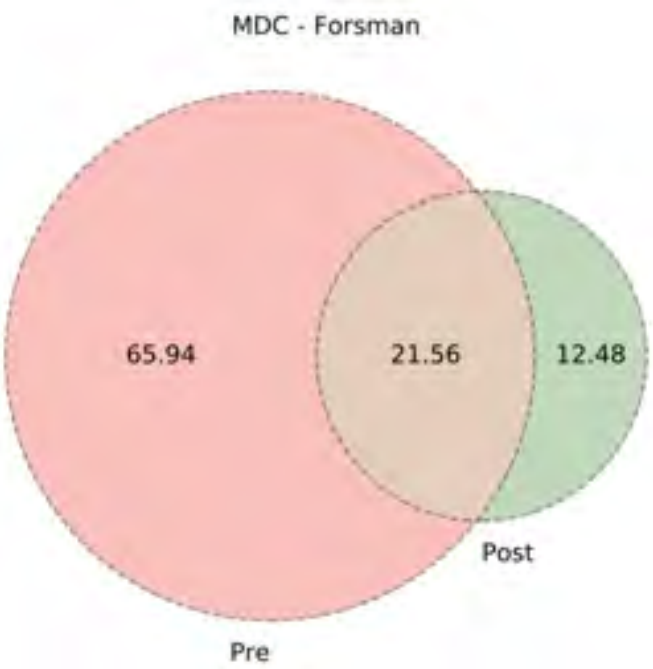
DMA strategies: effects of affiliation



Network Strategies: Coalitions and Market Split

▸ Case Study - DD

- One illustrative M&A per network ▸ DMA strategies
- Sample of common keywords (pre, post, or both) in a 2-years window around the acquisition ▸ All M&A



Outline

Question and Strategy

- How do changes in intermediaries' concentration affect Google's revenues?
- A baseline regression model would be:

$$ln(R^G_{mt}) = \beta DemandConcentration_{mt} + \phi X_{mt} + \tau_t + \gamma_z + \epsilon_{mt}$$

  - $R^G{}_{mt}$ = Search engine revenues (proxy)
  - $DemandConcentration_{mt}$ = Agency network conc.tion (proxy)
  - X_{mt} = Controls
  - τ_t & γ_z= year and thematic cluster/industry FE

- But three main challenges:
  1. Definition of the relevant markets
  2. Measurement of relevant quantities
  3. Causal identification of β

1) Market Definition: two-layer clustering

Advertisers' industries are *too broad*, but keywords are *too narrow*

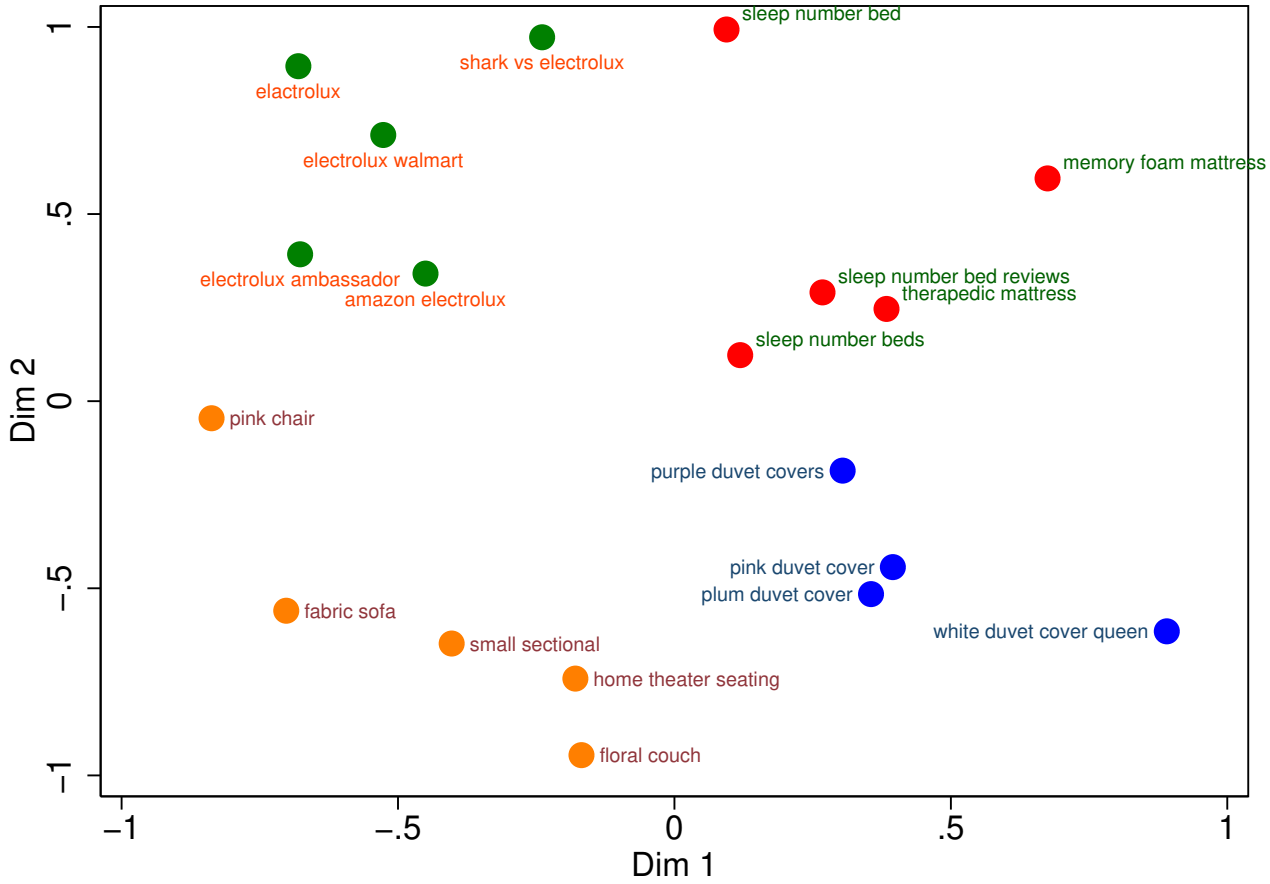
Our solution entails a two-layer clustering:

- Step 1: pool keywords together, but we have millions and many are related but not sharing any term. Solution: *GloVe*, unsupervised learning, pre-trained on 840B documents with 2.2M unique terms, from Common Crawl in English, featuring 300 dimensions ▸ details

Step 1: from Keywords to Thematic Clusters

Keyword	Industry
sleep number bed	Houseware
white duvet cover queen	Houseware
sleep number beds	Houseware
therapedic mattress	Houseware
memory foam mattress	Houseware
electrolux walmart	Houseware
elactrolux	Houseware
home theater seating	Houseware
amazon electrolux	Houseware
plum duvet cover	Houseware
shark vs electrolux	Houseware
pink duvet cover	Houseware
sleep number bed reviews	Houseware
purple duvet covers	Houseware
fabric sofa	Houseware
floral couch	Houseware
pink chair	Houseware
small sectional	Houseware
electrolux ambassador	Houseware

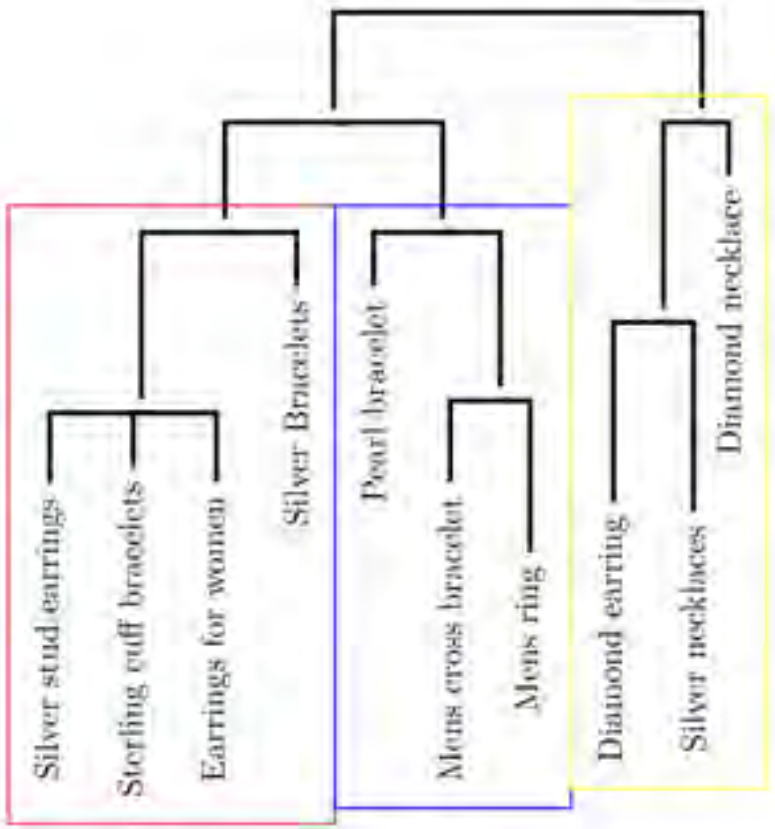
Step 1: from Keywords to Thematic Clusters



Step 2: Hierarchical clustering

- Step 2: Hierarchical clustering *within the thematic clusters of step 1* to account for competition (for any pair of keywords in a cluster, dissimilarity matrix built on co-occrrences of same advertisers)

Step 2: Hierarchical Clustering



Notes: Structure of competitive clusters: the three clusters - red, blue and yellow boxes - are identified through the Kelley, Gardner and Sutcliffe [1996] penalty parameter.

▸ descriptives

Thematic Clusters and Markets

	Thematic Clusters				Competitive Clusters (Markets)			
	Mean	SD	Median	Observations	Mean	SD	Median	Observations
Market Characteristics								
# Advertisers	6.7	10.5	3.0	8,324	4.0	4.8	3.0	25,947
# Keywords	116.1	180.3	55.0	8,324	37.2	104.9	4.0	25,947
# Networks	2.79	1.77	2	8,324	2.22	1.26	2	25,947
Competitive Clusters	5	5	3	8,324	-	-	-	-
Market Variables								
$log(R_{m,t})$	10.89	2.27	10.92	29,796	10.41	1.96	10.37	52,476
$HHI_{m,t}$	2,765	2,311	2,000	29,899	2,740	2,257	2,000	52,476
Long Tail	0.32	0.35	0.18	29,899	0.27	0.37	0.01	52,476
$\Delta R_{m,t}$	-0.05	1.78	0.00	21,256	0.40	1.53	0.28	43,973
# of Results (mil)	76.93	269.19	21.52	29,899	75.97	231.28	19.7	52,476
# Clusters			8,324				25,947	

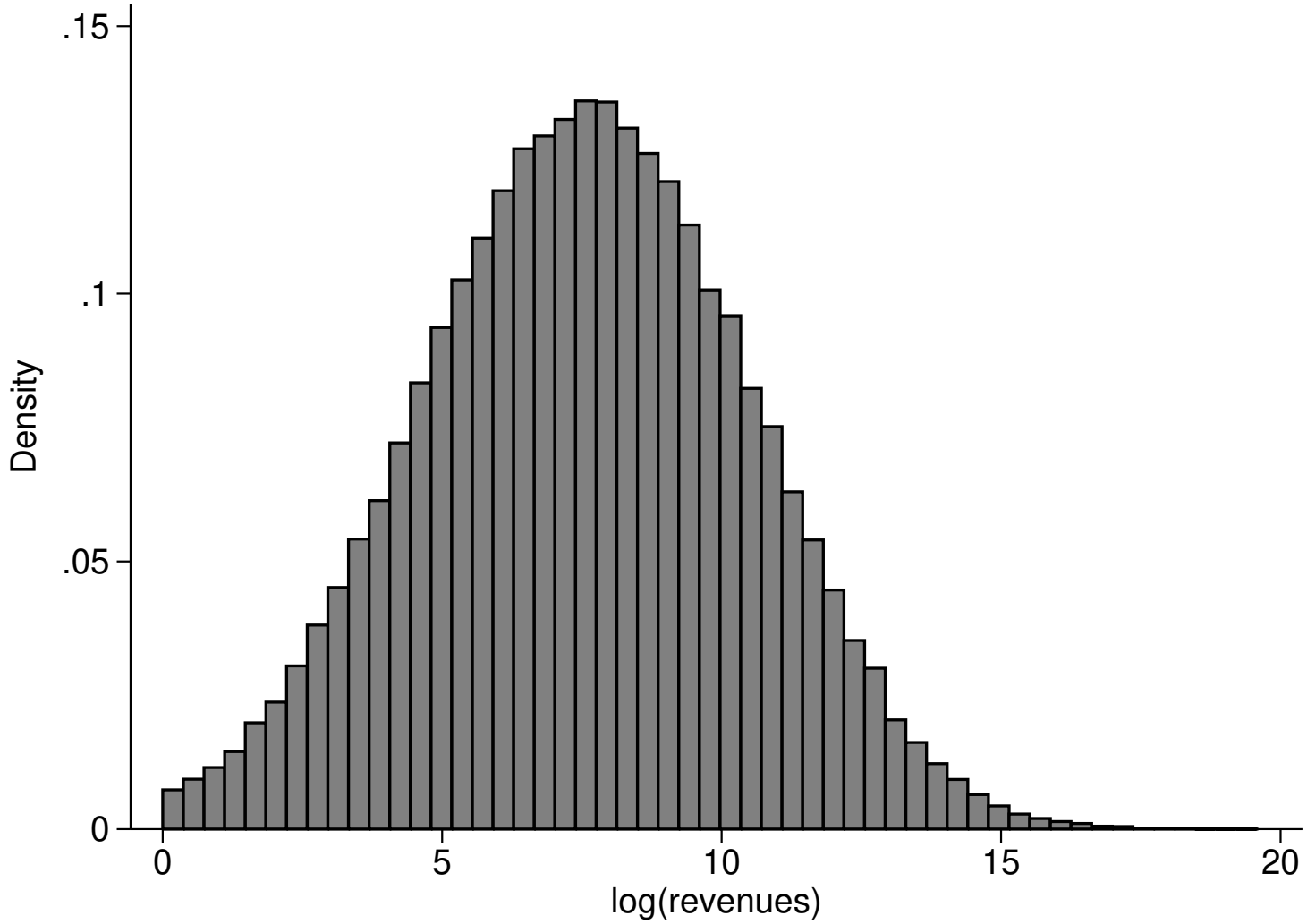
2) Measurement of the Main Variables

We compute a proxy for R^G using data on the $i = 1, ..., N_r$ keywords bid by the sample of Redbooks' advertisers:

$$R_{mt} = \sum_{k \in K_m} CPC_{kmt} * Volume_{kmt} * CTR_{kmt}$$

- CPC_{kmt}: average Cost-per-Click of keyword k in market m at time t
- $Volume_{kmt}$ is the overall number of searches of k over an year
- CTR_{kmt} is the cumulative Click-through-Rate of all the sponsored ad slots shown for keyword k

Distribution of $log(\hat{R})$



2) Measurement of the Main Variables

We compute a proxy for R^G using data on the $i = 1, ..., N_r$ keywords bid by the sample of Redbooks' advertisers:

$$R_{mt} = \sum_{k \in K_m} CPC_{kmt} * Volume_{kmt} * CTR_{kmt}$$

- CPC_{kmt}: average Cost-per-Click of keyword k in market m at time t
- $Volume_{kmt}$ is the overall number of searches of k over an year
- CTR_{kmt} is the cumulative Click-through-Rate of all the sponsored ad slots shown for keyword k

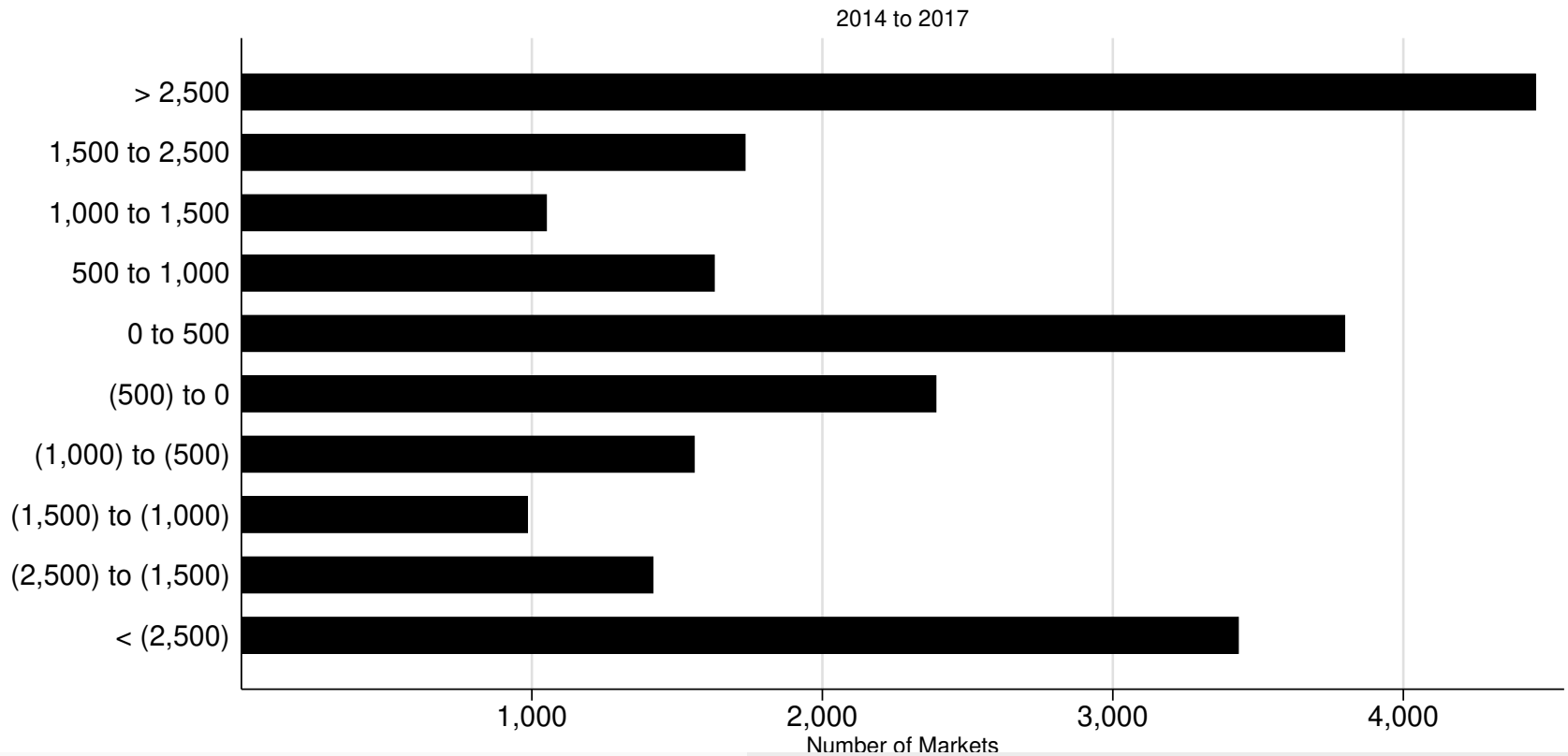
And a proxy for demand concentration: $HHI_{mt} = \sum_{i=1}^{I} (s^i{}_{mt})^2$

- Market size (S_{mt}): sum of all the clicks of all the ad slots allocated in all the keywords in m: $S_{mt} = \sum_{k \in K_m} Volume_{kmt} * CTR_{kmt}$
- For intermediary i, representing the set of advertisers A_i, the market share in market m at time t is:
  $s^i_{mt} = \frac{1}{S_{mt}} \sum_{a \in A_i} \sum_{k \in K_m} \sum_{j \in J_k} CTR_{jkmt} * Volume_{kt} * 1\{a \text{ occupies } j \in J_k\}$

Change in local concentration - 2014 to 2017

descriptives-mkt

- we observe 21 M&A and 2 divestures
- $HHI_{m,2017} - HHI_{m,2014}$
- $HHI \in [0 - 10,000]$



3) Causal Identification: IV Approach

- OLS unlikely to deliver causal effect due to OVB. Example: media attention to a phenomenon changes keyword entry/bid
- We adapt ideas from Dafny et al. (2012) of using M&A events as shocks to "local" market concentration
- Hence, if in year t intermediary α merges with intermediary β, the merger-induced change in HHI is: details

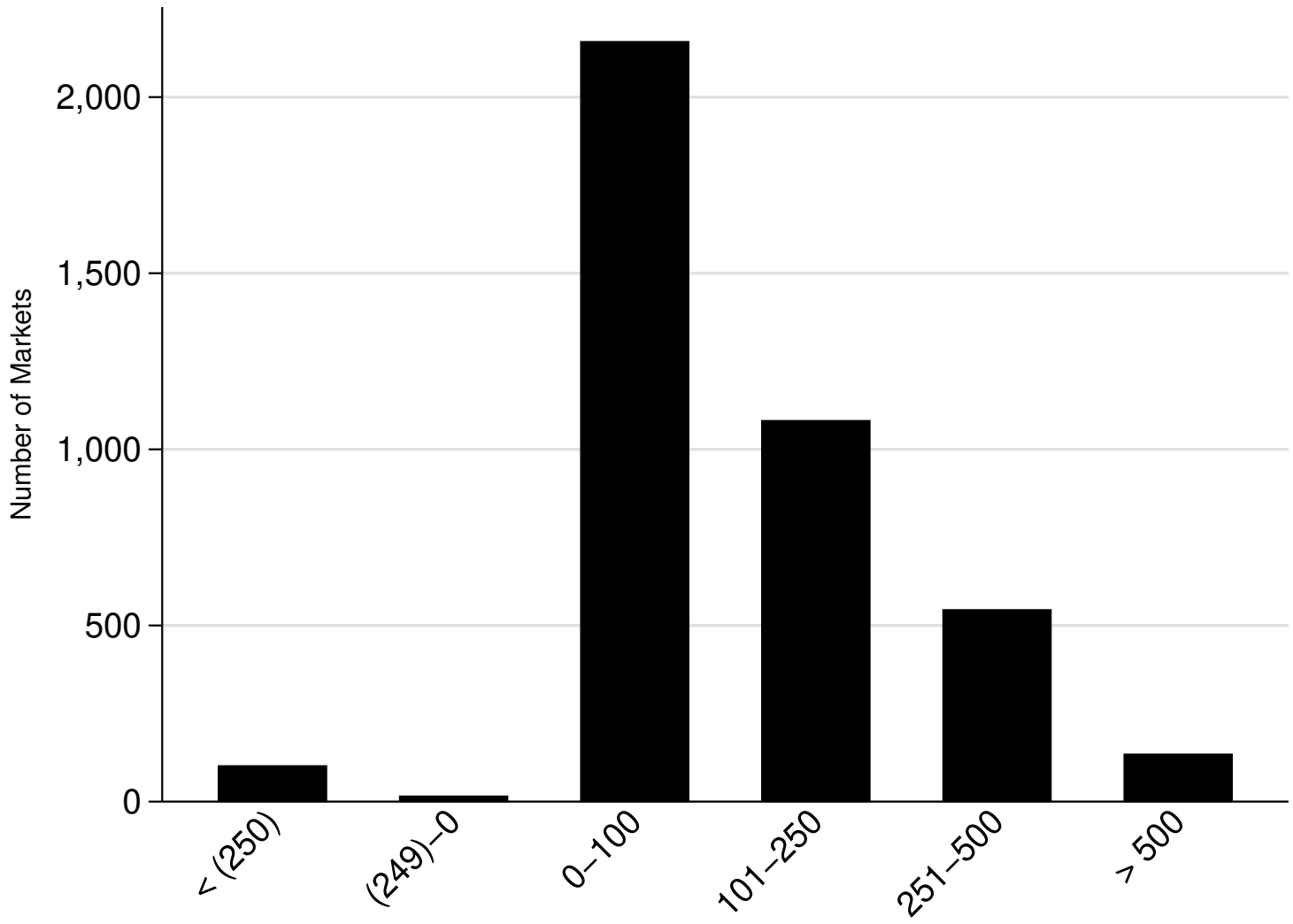
$$sim\Delta HHI_{mt} = \underbrace{(s^{\alpha}_{m,t} + s^{\beta}_{m,t})^2}_{\text{Share of merged firm } \alpha+\beta} - \underbrace{((s^{\alpha}_{m,t})^2 + (s^{\beta}_{m,t})^2)}_{\text{Shares of single firms } \alpha \text{ and } \beta}$$

- Alternatives: we might want to exclude mergers too likely to be driven by specific keywords (too "local"); few overlapping markets; mergers with insufficient pre or post periods pre/post

Merger Events

Agency	Acquiring Network	Acquisition year	Number of Advertisers	Number of Industries	Number of Markets
The Brooklyn Brothers	IPG	2016	6	2	23
Essence Digital Limited	WPP	2015	1	1	145
Quirk	WPP	2015	5	2	272
SHIFT Communications	WPP	2017	13	8	1,049
Deeplocal Inc.	WPP	2017	5	1	117
Maruri GREY	WPP	2017	1	1	150
Zubi Advertising Services, Inc.	WPP	2017	3	2	345
Campfire	Publicis	2015	3	1	27
La Comunidad	Publicis	2015	9	5	271
Sapient Corporation	Publicis	2015	17	6	1,038
Blue 449	Publicis	2016	4	2	93
Forsman & Bodenfors	MDC	2017	5	1	315
Formula PR	Havas	2015	6	4	309
FoxP2	Dentsu-Aegis	2015	1	2	42
Rockett Interactive	Dentsu-Aegis	2015	1	1	22
Covario, Inc.	Dentsu-Aegis	2015	3	1	78
Achtung	Dentsu-Aegis	2016	2	1	226
Gravity Media	Dentsu-Aegis	2016	5	3	433
Grip Ltd.	Dentsu-Aegis	2016	3	2	92
Merkle	Dentsu-Aegis	2017	18	7	973
Gyro	Dentsu-Aegis	2017	12	6	363

Distribution of *simΔHHI*



Results: Baseline Estimates (Sample selection: 75^{th} pct. largest markets w/o mergers)

	(1)		(2)		(3)		(4)		(5)	
	RF	FS	RF	FS	RF	FS	RF	FS	RF	FS
sim$\Delta\hat{HHI}$	-6.761***	0.618***	-4.070***	0.957***	-3.842***	0.830***	-3.831***	0.829***	-3.723***	0.831***
	(1.110)	(0.170)	(1.133)	(0.0790)	(1.162)	(0.0914)	(1.165)	(0.0915)	(1.165)	(0.0913)
Weak Id. F-Test		13.21		146.99		82.37		82.18		82.94
Underid. F-test		4.56		13.67		11.02		11.01		11.02
Observations	52,476	52,476	52,476	52,476	52,476	52,476	52,476	52,476	52,476	52,476
Cluster FE			✓		✓		✓		✓	
Year FE					✓		✓		✓	
Organic Results							✓		✓	
Keyword Characteristics									✓	

	OLS						IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\hat{HHI}$	-2.217***	-2.120***	-2.129***	-2.122***	-2.130***	-10.93***	-4.252***	-4.630***	-4.620***	-4.479***
	(0.0718)	(0.0567)	(0.0573)	(0.0572)	(0.0569)	(2.902)	(1.068)	(1.200)	(1.204)	(1.201)
Organic Results (billion)				0.252***	0.263***				0.206***	0.225***
				(0.0437)	(0.0458)				(0.0463)	(0.0477)
Keywords Characteristics										
Branded Keyword					0.396***					0.458***
					(0.0537)					(0.0639)
Long-tail Keywords					-0.0908**					-0.0491
					(0.0367)					(0.0423)
R^2	0.07	0.62	0.62	0.62	0.62					
Observations	52,476	52,476	52,476	52,476	52,476	52,476	52,476	52,476	52,476	52,476
Cluster FE		✓	✓	✓	✓		✓	✓	✓	✓
Year FE			✓	✓	✓			✓	✓	✓

Magnitudes: Why So Large?

Two main motives:

- Short run vs. dynamic response by Google
- Lack of strategy proofness: even small HHI increases can trigger a large revenue drop. Example:

Advertiser	Valuations $k1$	Valuations $k2$	Bids for $k1$	Bids for $k1$ post merger	Market shares	Market shares post merger
a_1	5	5	b_1	b_1	0.541	0.541
a_2	4	4	3.15	2.90	0.270	0.270
a_3	3	2	2.30	1.80	0.095	0.068
a_4	2	3	1.60	0.60	0.095	0.068
a_5	1	1	1.00	0	0.000	0.054
			Tot.Rev=96	Tot.Rev.=79	HHI=3,831	HHI=3,864

Pct. Revenue Change: -18% **HHI Change: 33-point**

Robustness and Extensions

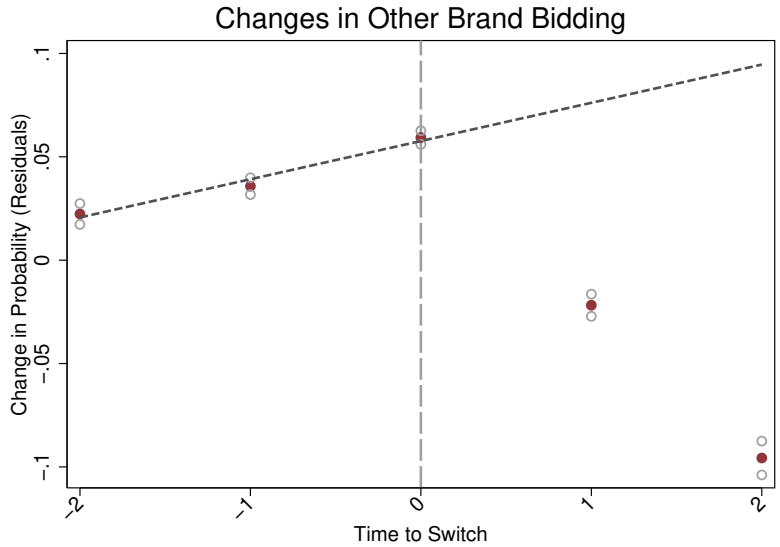
- **Robustness**
  - IV validity: largest mergers → Table
  - Different definition of clusters → Table
  - Alternative proxies for R_{mt} and HHI_{mt} → Robustness
- **Channels and Validation**
  - Channels: CPC, Volume and Number of Keywords
  - Heterogeneous effects at industry level → β_{IV} industry-level
  - Cluster validation → Amazon Mechanical Turk
- **Extra**
  - Sample selection → Table
  - "Merged" markets only → β_{OLS} and β_{IV}
  - Keyword type (length; long tail; branded; etc.) → DMA effect

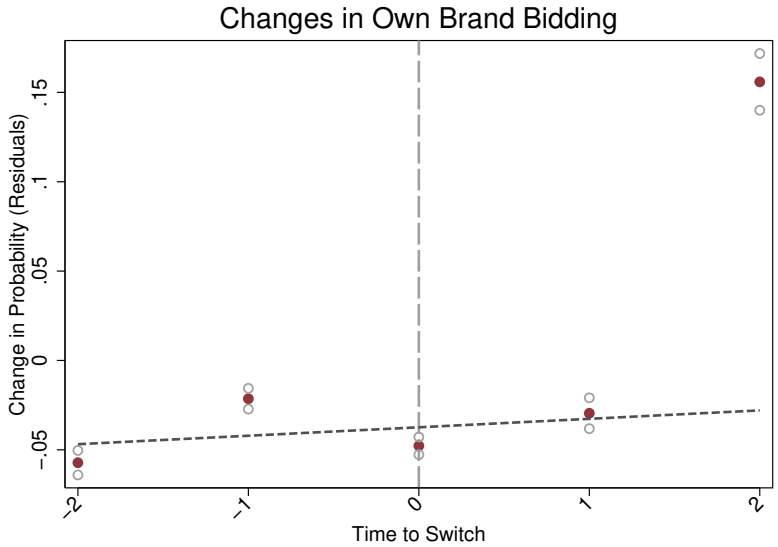
Results: Different Channels (IV estimates)

	$log(cpc)$	$log(vol)$	$log(\#keys)$
	(1)	(2)	(3)
$\hat{HHI}$	-1.286***	-0.546	-0.956
	(0.447)	(1.015)	(0.726)
Observations	52,476	52,476	52,476

Changes in Own and Other Brand Keywords

Large shares of marketing budgets spent for ads own brands and those of rivals [Blake, Nosko and Tadelis, 2015; Simonov, Nosko and Rao, 2018; Simonov and Hill, 2019]. M&As impact this margin:





The dashed back line is the linear fit of the pre-merger years, projected on the post-merger period

Outline

Conclusions (1/2)

Main findings:

- First evidence that intermediaries' concentration reduces Google's revenues
- Novel approach for market definition in sponsored search

Looming open questions:

- Is intermediary coordination socially desirable?
- Is there a role for a public intervention?

Conclusions (2/2)

Is intermediary coordination socially desirable? Depends on:

- pass-through to advertisers/consumers. Intermediary sector reasonably competitive but 4 concerns: intermediaries' concentration, low transparency, advertisers' biases, common ownership
- other factors: impacts on smaller platforms (Bing, etc.)

Is there a role for a public intervention?

- Current ideas all involve lowering Google's market share:
  - Sharing query data (w. delay?) $\rightarrow$ hurt innovation incentives!
  - Default options on devices $\rightarrow$ hurt network effects!
- Buyer power less problematic, but might need public intervention to prevent abuses in Google's response:
  - Higher reserve prices: Google increased them in May 2017
  - Disintermediation: DoubleClick Search to replace agencies