

# Differential Impacts of Online Ratings in the Market for Medical Services

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Presenter: Aaron P. Kaye, University of Michigan

Michael Luca, Harvard Business School

Sonal Vats, Boston University

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# Motivation: Online Reputation and Medical Services

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Online ratings and reviews are an increasingly important driver of economic activity and consumer decision-making

- Top Industries: Restaurants, Hotels, **Medical Services** ([Local consumer Review Survey 2020](#))

Physician services are a credence good, meaning consumers face ex-ante and ex-post uncertainty about quality

- Ex-ante uncertainty – like experience goods, ratings could provide useful information
- Ex-post uncertainty – unclear what information ratings include

Reputation systems could mitigate or exacerbate existing disparities in the medical services industry

Studying a platform with building ratings and booking allows us to better understand important mechanisms in this market

# Introduction

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## Research questions

- What is the impact of ratings on demand for physician services?
- Investigate differential impact of ratings depend on other characteristics?

## Context

- Primary Care Physicians on ZocDoc.com in 8 Metropolitan Divisions Feb 2016 - April 2017

## Data sources

- Physician Information – Profile information (PCPs) collected by scraping ZocDoc
- Patient volume – Imputed from scraping physician schedules

## Methodology

- Regression discontinuity design with multiple cumulative cutoffs (RDMCC)

## Differential impact - Repeat analysis for economically interesting subgroups

- Physician Gender
- Number of Ratings (Bayesian learning)
- Hospital Affiliation (other quality signal)

# Background – Recent Literature

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## Impact of Ratings in Healthcare

- Patients are willing to travel further to receive care from hospitals with higher Yelp ratings (McCarthy, Sanbower, and Sánchez Aragón, 2022)
- Positive ratings increase general practitioner enrollment (Brown, Hansman, Keener, and Veiga, 2023)

## Differential Impact of Ratings and Quality Signals

- Impact of ratings could be mediated by private information (Brown, et al ,2023)
- Signals of doctor quality reduce 90% of the racial gaps in willingness to pay (Chan, 2022)
- Women surgeons experience a larger drop in referrals after a patient death (Sarsons, 2017)
- Platform mechanics mediate the impact of ratings (Athey, and Kaye, in progress)

# Background on ZocDoc.com: An Online Doctor Reservation Platform

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## Company timeline:

- 2007: Founded
- 2015: Valued at \$1.8 billion

Revenue model charges physicians not patients

- 2015-2018: Physicians subscribe to \$300 monthly or \$3000 annual contracts
- 2018-2019: Shifted to per-booking fee

Patients can search for physicians by

- insurance, location, specialty etc. and book an appointment

## Key features:

- Bundles reviews with appointments
- Verified reviews, less potential for review fraud
- Closed loop review System
- Doctors cannot screen patients

# Background on ZocDoc

**Leave feedback for Andrew J. Parker, MD**

Please help your fellow patients by leaving feedback. For more information, check out our [rating policy](#).

**Would you recommend this professional?**

-  Highly Recommended!
-  Probably
-  Maybe
-  Probably Not
-  Never!

**How would you rate this professional's bedside manner?**

-  Excellent
-  Good
-  Satisfactory
-  Unsatisfactory
-  Awful

**How long was the wait time in the office before you were seen?**

-  Right Away!
-  Less Than 30 Minutes
-  Between 30 and 60 minutes
-  More Than One Hour
-  More Than Two Hours

Sure! Use my name in this review.  
 Show my appointment date in this review

  
Andrew J. Parker MD  
Ear, Nose & Throat Doctor  
  
148 East Avenue  
Suite 2-I  
Norwalk, CT 06851

Friday, September 6 - 2:00 PM  
Patient  
Sonal Vats  
Reason for Visit  
ENT Consultation

We protect your privacy. Read our [Privacy Policy](#) to learn more.

**Zocdoc**

List your practice on Zocdoc

enter specialty, condition, doctor name...

Boston, MA, United States

insurance carrier and plan

Any Gender Male Female Any Day Today Next 3 Days More

Sorry, no results found. If you need a doctor to diagnose you, here are PCPs in your area. Sort by: default order

Fri Jul 7 Sat Jul 8 Sun Jul 9

  
Dr. Eyad Mayani, DMD  
Dentist  
  
"Had my wisdom teeth pulled. The experience was so positive and..."  
1 International Place, Boston, MA 02110  
Within 0.5 mile  
Next availability: Mon, Jul 10

  
Dr. Xinheng Zhu, OD, PhD  
Optometrist  
  
"Wonderful Doctor. Highly recommended."  
65 Harrison Aven, Boston, MA 02111  
Within 1 mile  
9:30 am  
10:00 am  
10:30 am  
11:30 am

  
Dr. Maria Gorbovitsky, MD  
Internist  
  
"Very nice, goes out of her way to make sure you feel comfortable regardless of the..."  
252 Tremont Street, Boston, MA 02116  
Within 1 mile  
Next availability: Mon, Jul 10

Find Doctors and Book Appointments  
Managing your health has never been easier with Zocdoc. Search for your doctor, view their availability, and book an appointment online.

Read More...

Map data ©2017 Google

# Preview of Findings

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## Descriptive Evidence

- Booking likelihood: More likely to be booked
- Booking speed: Booked further in advance

## Regression Discontinuity at 5-Stars

- Patient volume via bookings: Approx. twice as many bookings
- Patient volume via vacancies: Approx. half as many vacancies

## Differential Impact

- Physician gender: Effect greatest for women physicians
- Number of ratings: Effect increases with number of ratings
- Hospital affiliation: No significant difference

## Robustness

- Placebo tests: Effect greatest at true cutoff
- Rating manipulation: Bunching above cutoff

# Data

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COLLECTION

SAMPLE RESTRICTIONS

# Data Collection

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Data Collected by Crawling ZocDoc's website

Time Period

- February 25, 2016 – April 17, 2017

Profile photos processed with Microsoft Face API

Region – Coordinates in the following Metropolitan Divisions

Metro Division	Apts.	PCPs
<i>Boston, MA</i>	86,512	117
<i>Cambridge-Newton-Framingham, MA</i>	71,159	68
<i>Chicago-Naperville-Arlington Heights, IL</i>	795,000	331
<i>Fort Lauderdale-Pompano Beach-Deerfield, FL</i>	184,185	80
<i>New York-Jersey City-White Plains, NY-NJ</i>	3,629,392	1,291
<i>San Francisco-Redwood City-South San Fr., CA</i>	69,384	31
<i>Silver Spring-Frederick-Rockville, MD</i>	232,236	82
<i>Washington-Arlington-Alexandria, DC-VA-MD</i>	774,756	305

# Sample Selection

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## Appointment Sample

- Appointment type: new patient, illness, cross-listed
- Appointments on weekdays between 8am and 6pm
- At least one appointment available three weeks in advance

## Physician-week sample

- “Stable” half star rating
  - 90% of observation at this rating
- Remove physicians with deleted reviews
  - More than 4 weeks with a decrease in number of reviews
- At least 8 ratings
- At least one appointment available three weeks in advance

# Empirical Strategy

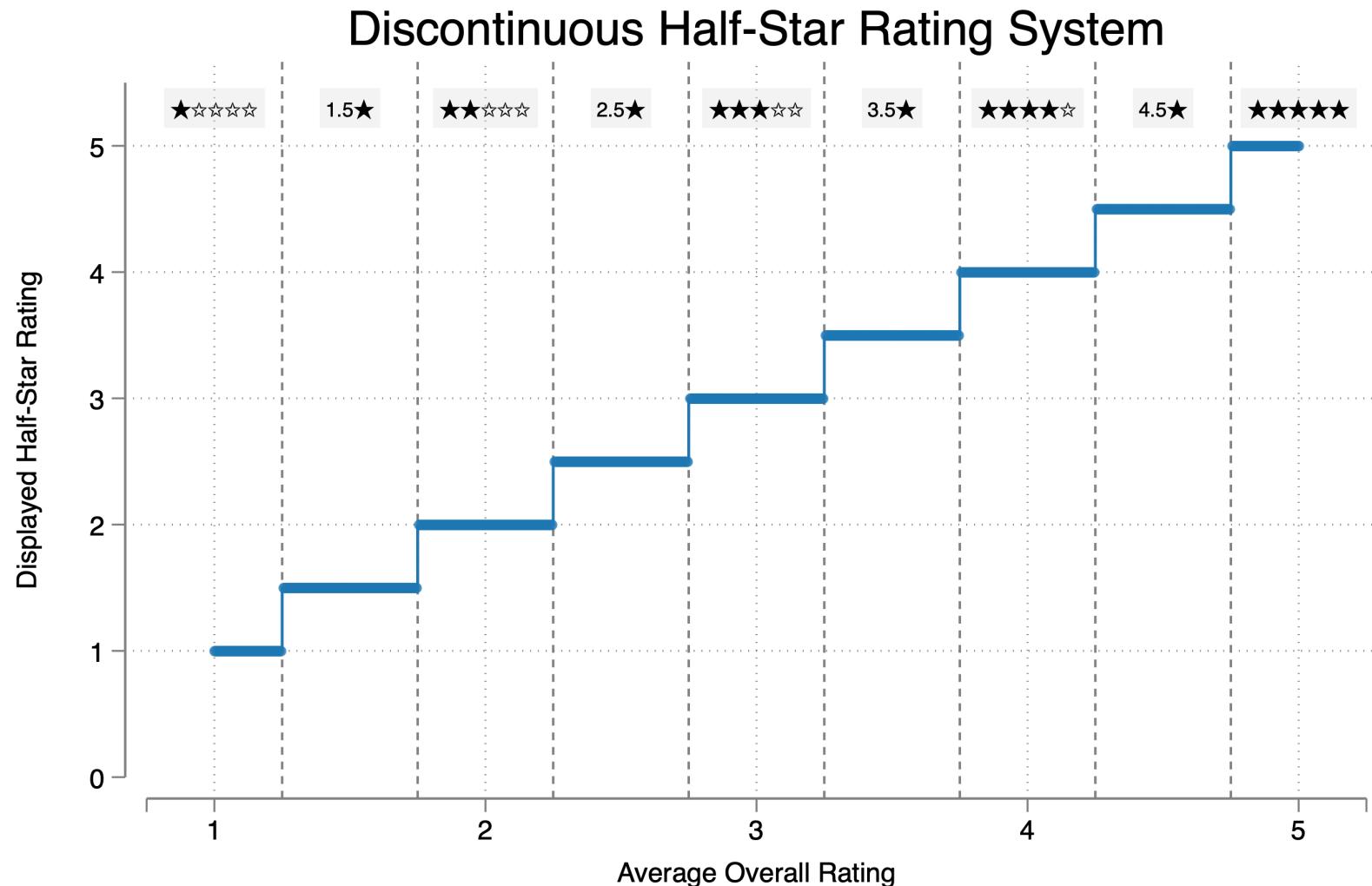
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FIRST STAGE: HALF-STAR RATINGS

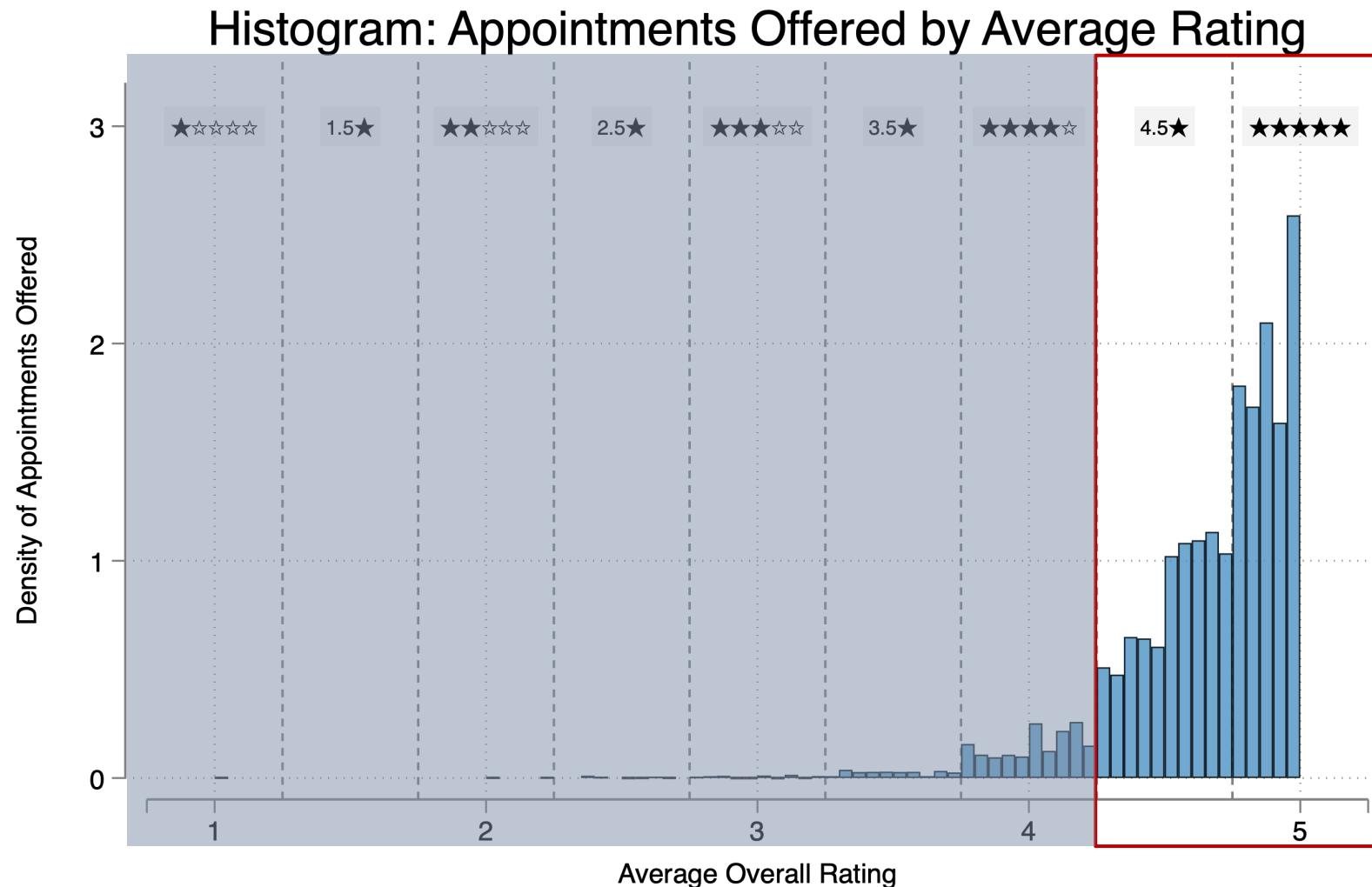
DESCRIPTIVE EVIDENCE

PRIMARY SPECIFICATION

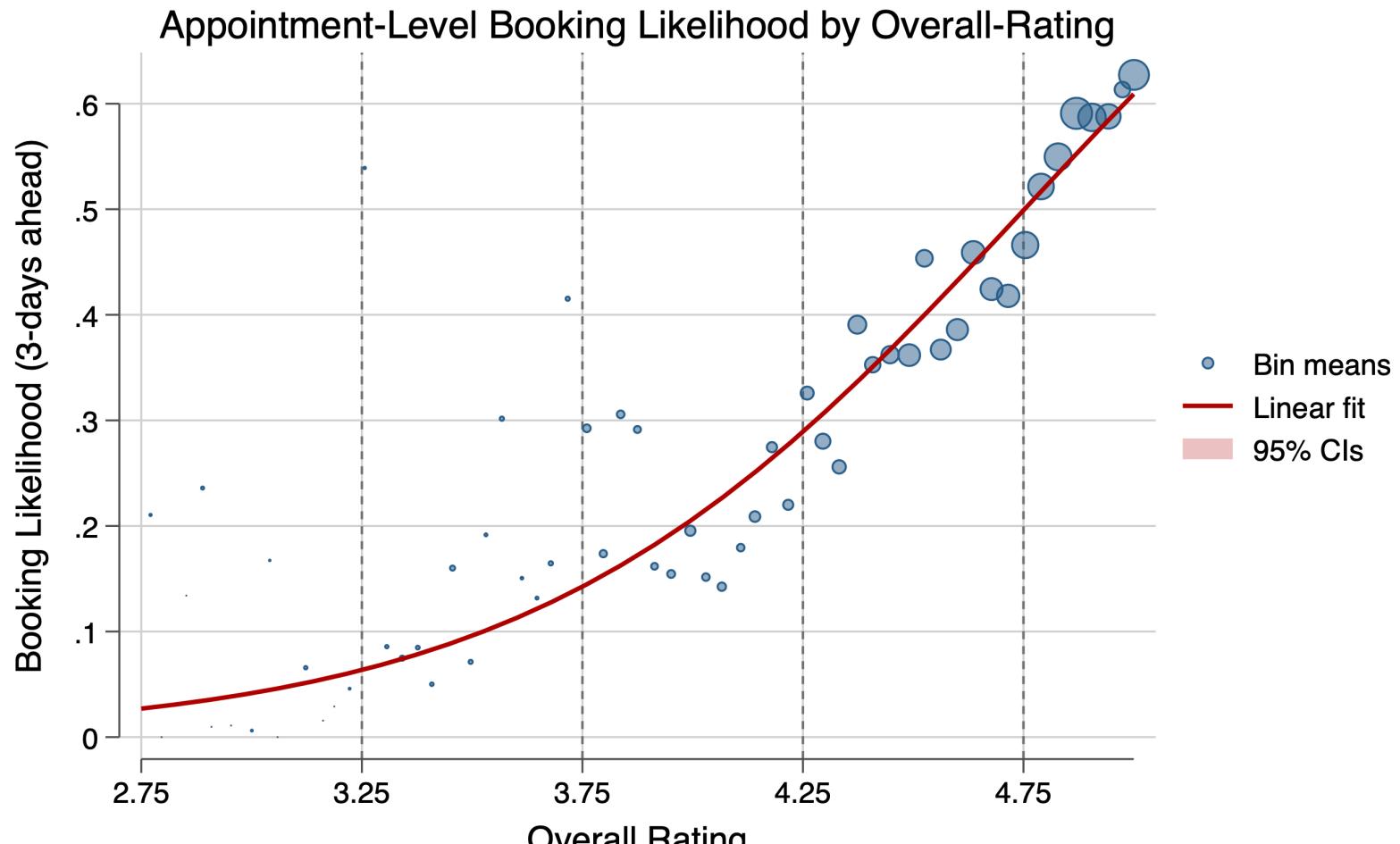
# Empirical Strategy: regression discontinuity w/ multiple cumulative cutoffs



# Empirical Strategy



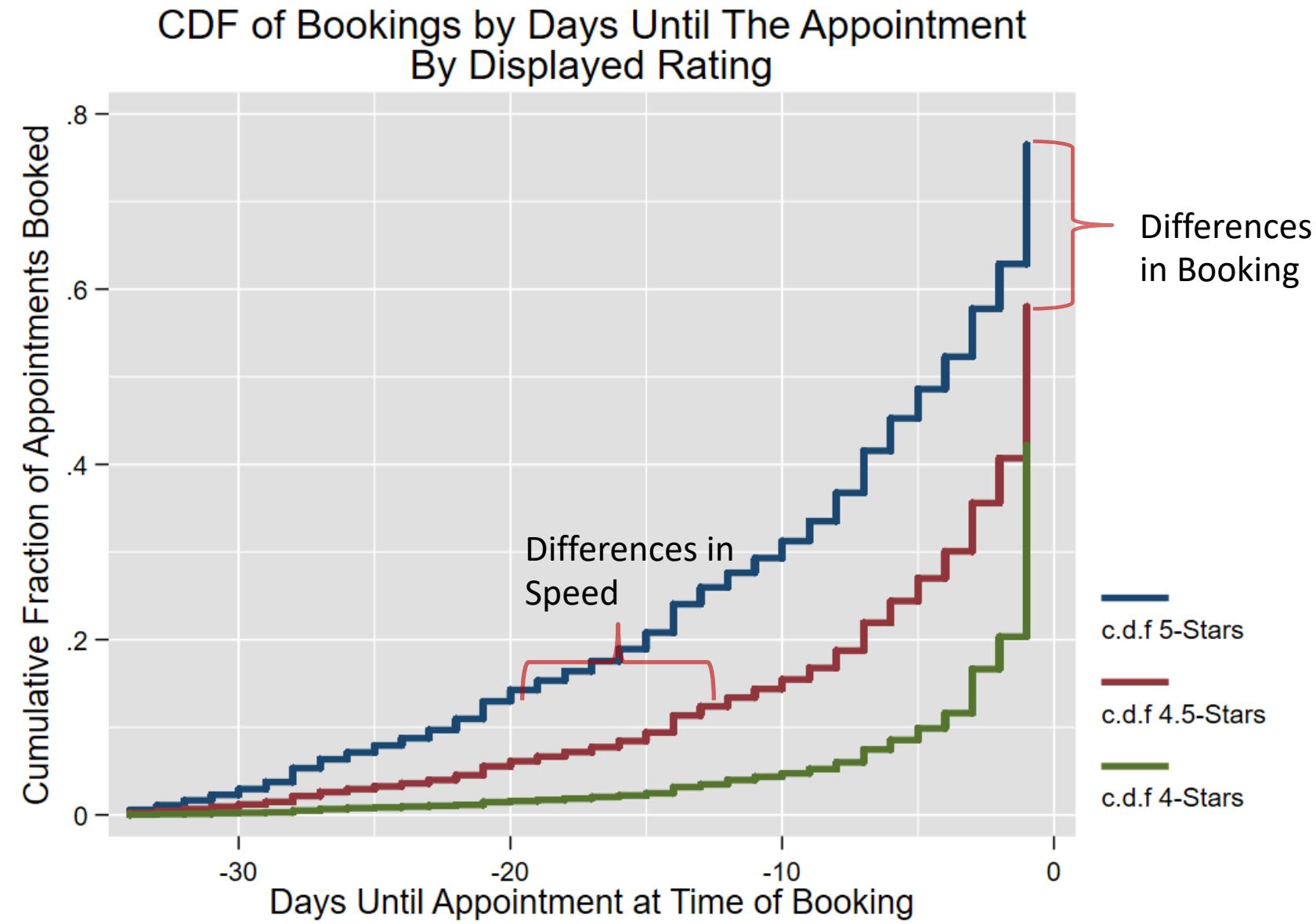
# Booking Likelihood by Rating



Sample: 2/24/2016-4/17/2017, primary care, min 8 ratings, with apts offered during business hours  
Controls: None

# Preliminary Results: Booking by Time (CDF Comparison)

- **The vertical difference:** difference in percent of appointments booked at a given number of days in advance.
- **The horizontal differences:** The difference in how many days in advanced the same percent of appointments were booked.



# Empirical Strategy: Primary Specification

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**Observation level:** Physician-week

**Dependent variable:** Weekly patient volume based

- Inverse Hyperbolic Sign (IHS) of bookings
- IHS vacant appointments (alternative)

**Running variable:** Average overall rating

**Covariates:** Market-week, IHS(offered appointments), number of location, appt length and type no. reviews, hospital affiliation

**Methods:**

- Asymmetric data-driven MSE-optimal bandwidth selectors
- Triangular kernel
- Mass point adjustments
- Bias-corrected RD estimates with robust variance estimator
- Cluster-robust nearest neighbor variance estimation clustered on physician (panel data)

# Results

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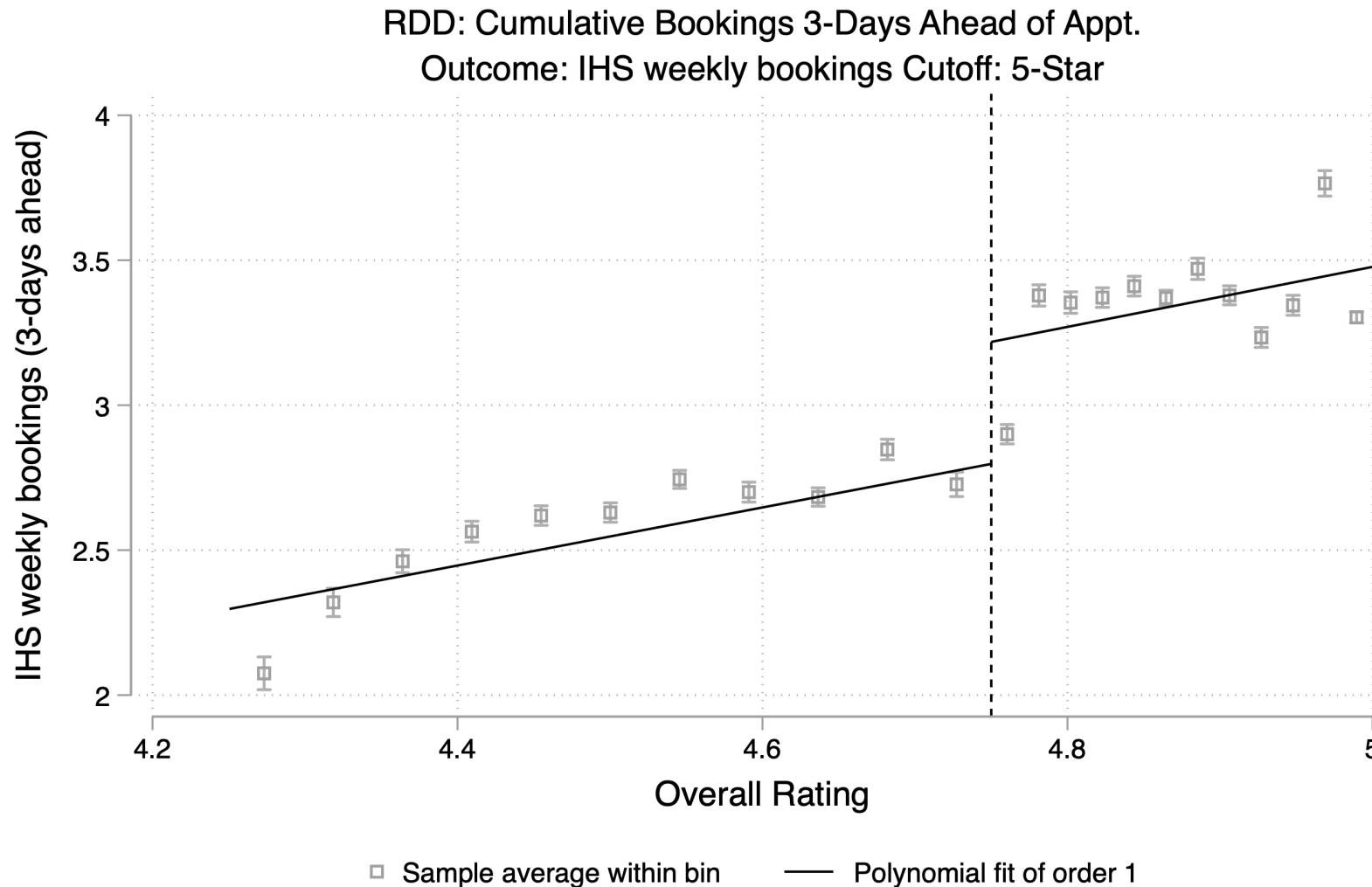
PRIMARY SPECIFICATION

ALTERNATIVE SPECIFICATIONS

DIFFERENTIAL IMPACTS

ROBUSTNESS CHECKS

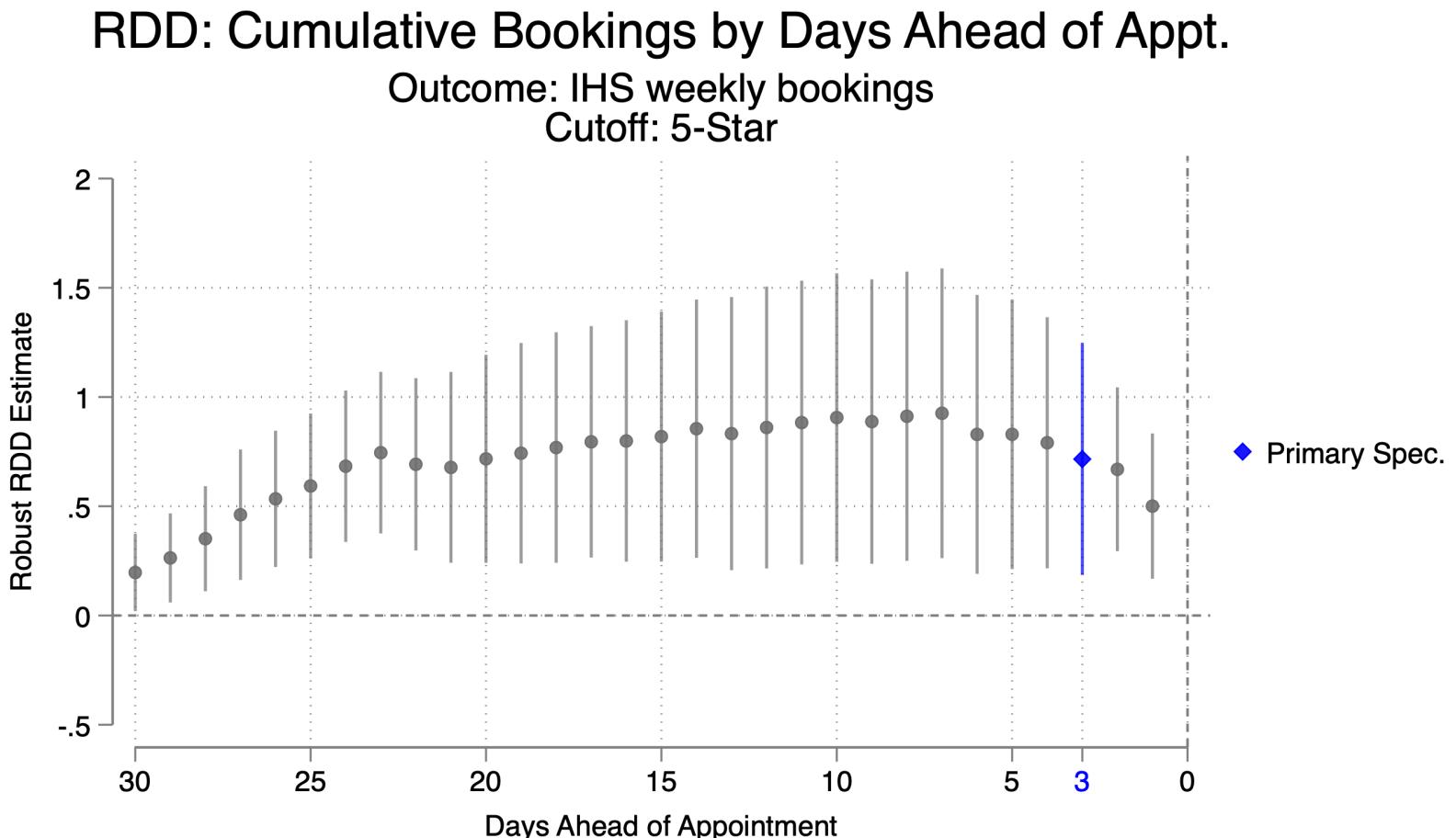
# Impact of Ratings on Patient Volume: Approx. Doubling of Bookings



Method	(1) IHS(Weekly Bookings)
Conventional	0.686*** (0.228)
Bias-corrected	0.716*** (0.228)
Robust	0.716*** (0.271)
Observations	54263
Controls	X

Details

# Impact of Ratings on Patient Volume: Approx. Doubling of Bookings

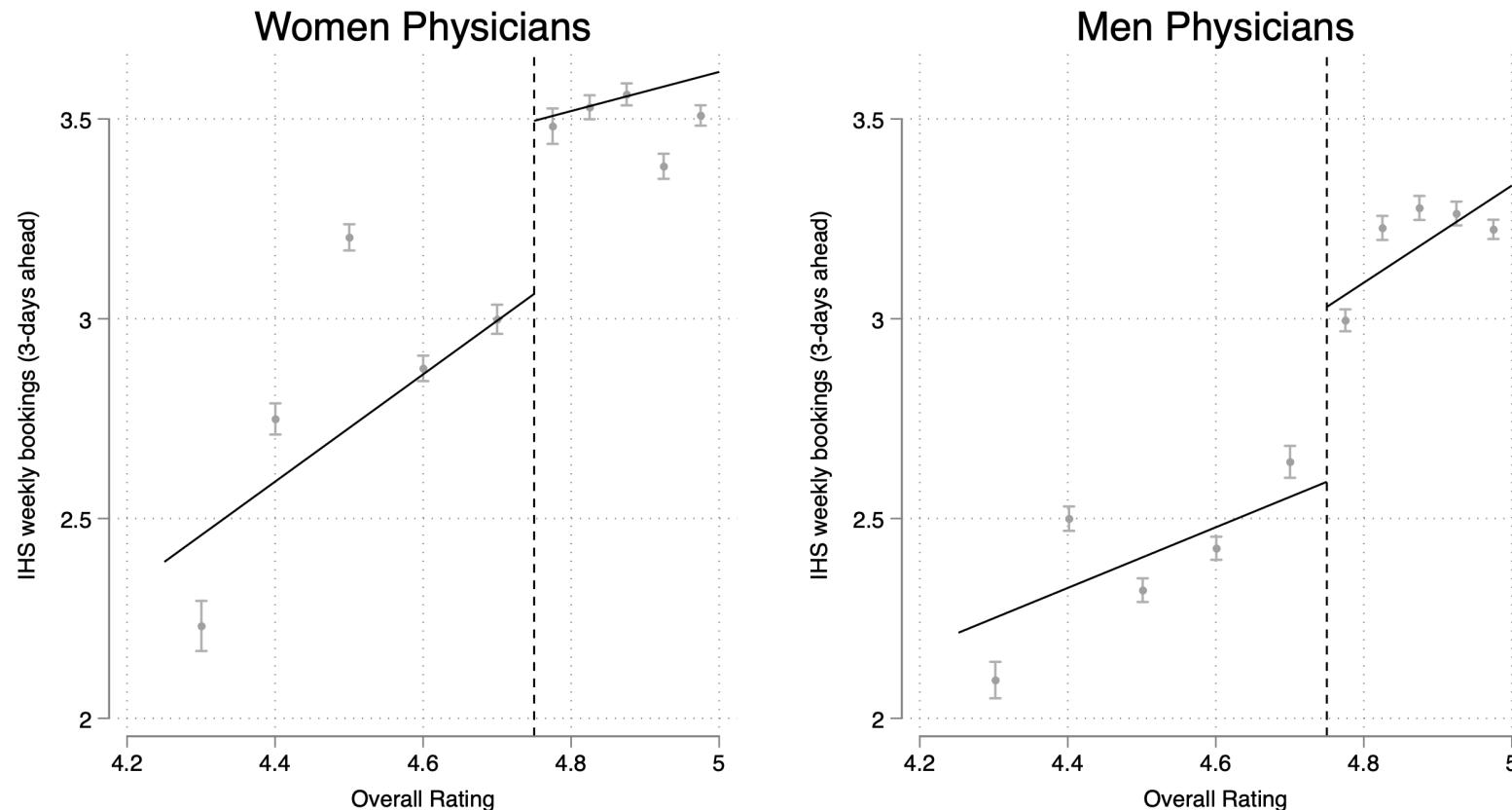


Controls: market-week, no. locations, appt length, appt type, no. reviews, hospital affiliation  
Sample: 2/24/2016-4/17/2017, primary care, min 8 ratings, with appts offered during business hours 21 days in advance, stable ratings, excludes profiles with >4 rating removals  
Specification: data-driven asymmetric bandwidth, triangular kernel, NNcluster on physician

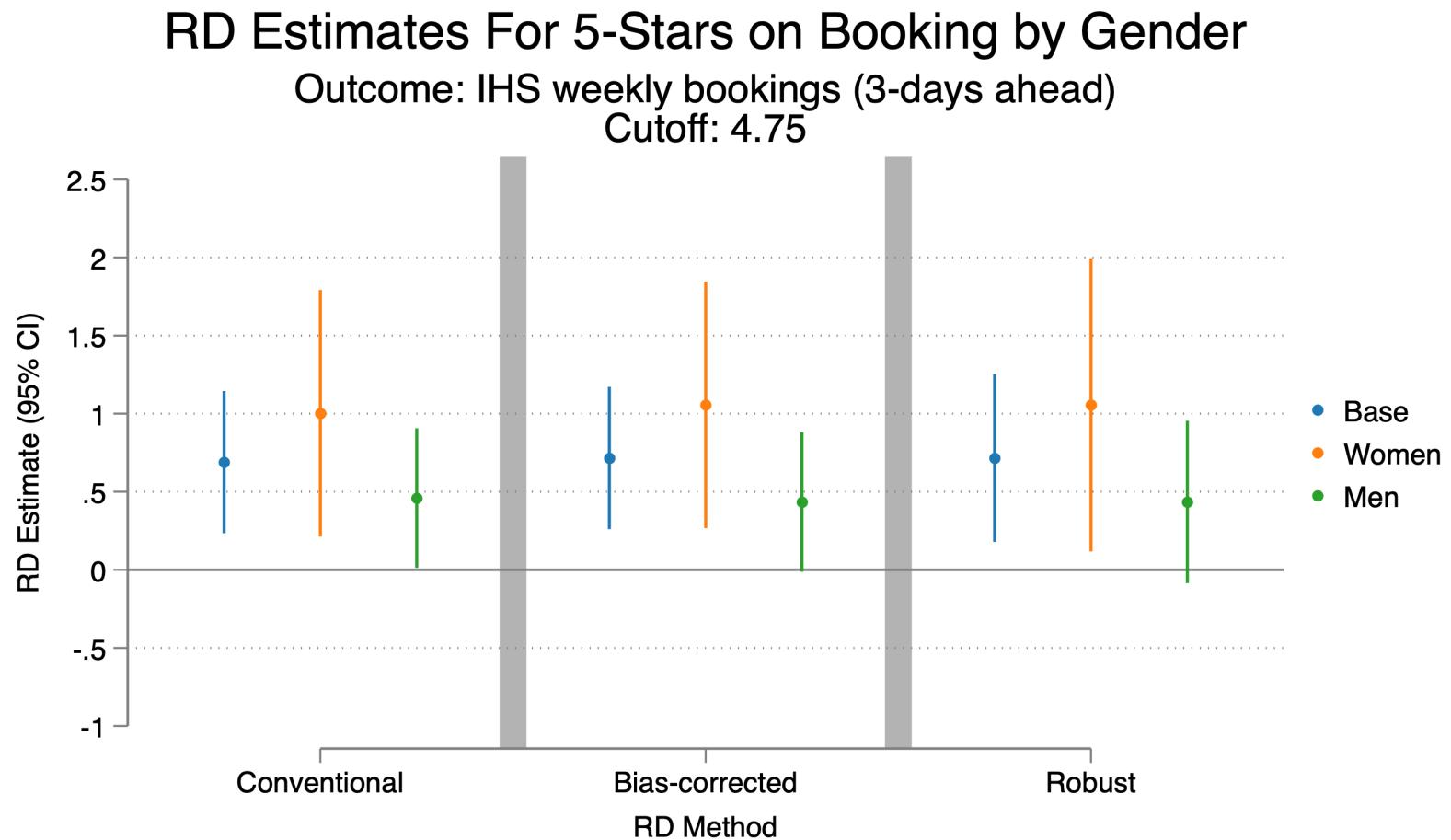
Vacancy Results

# RD Plot by Physician Gender: Women Have More Bookings at 4.5 and 5 Stars

**RDD: Cumulative Bookings 3-Days Ahead of Appt.**  
Outcome: IHS weekly bookings  
Cutoff: 5-Star



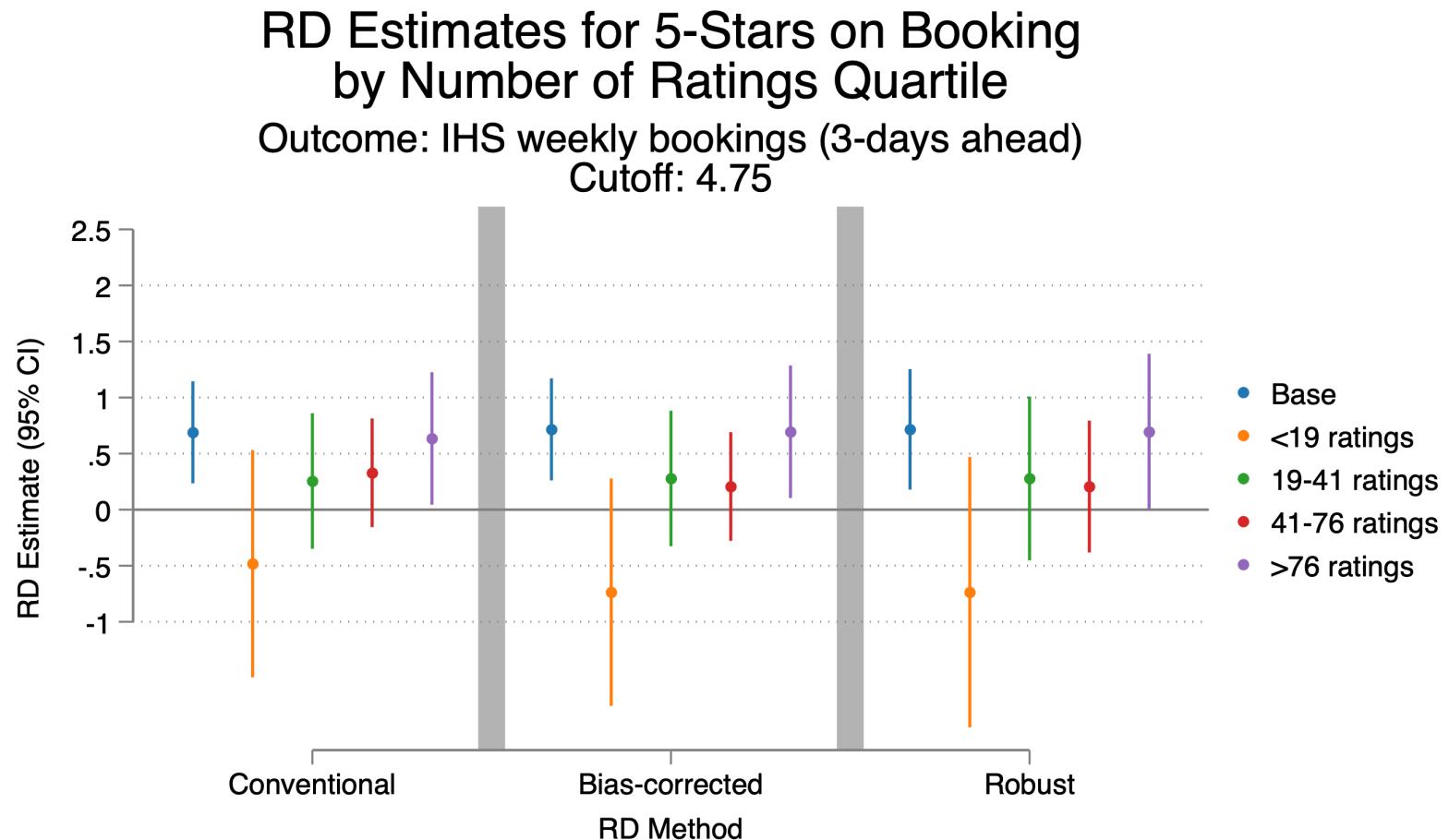
# Differential Impact of by Gender: Effect Greatest for Women



Controls: market-week, no. locations, appt length, appt type, no. reviews, hospital affiliation, offered appts  
Sample: 2/24/2016-4/17/2017, primary care, min 8 ratings, with appts offered during business hours 21 days in advance,  
stable ratings, excludes profiles with >4 rating removals  
Specification: data-driven asymmetric bandwidth, triangular kernel, NNcluster on physician

Details

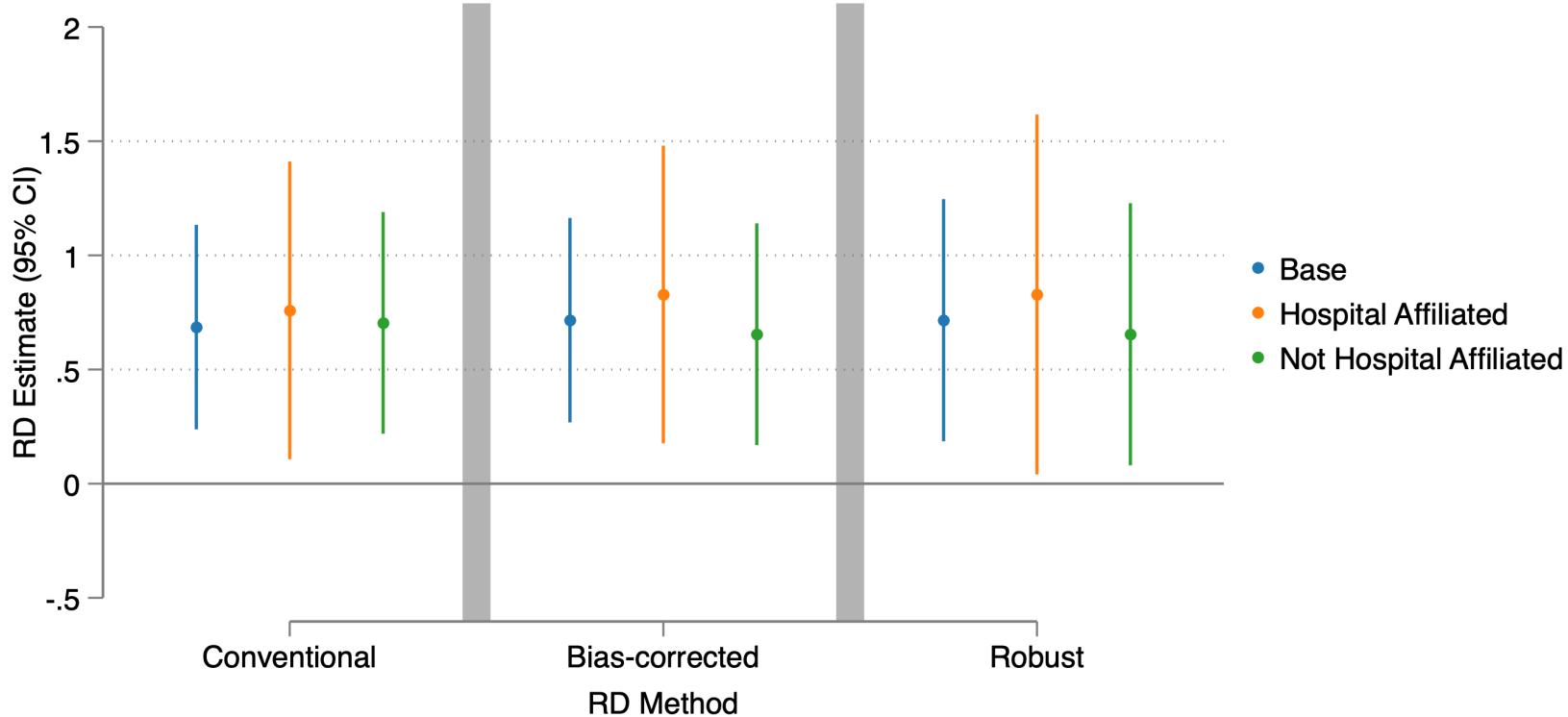
# Differential Impact of by Ratings: Effect Increases with No. Ratings



# Differential Impact of Hospital Affiliation: Similar Effects

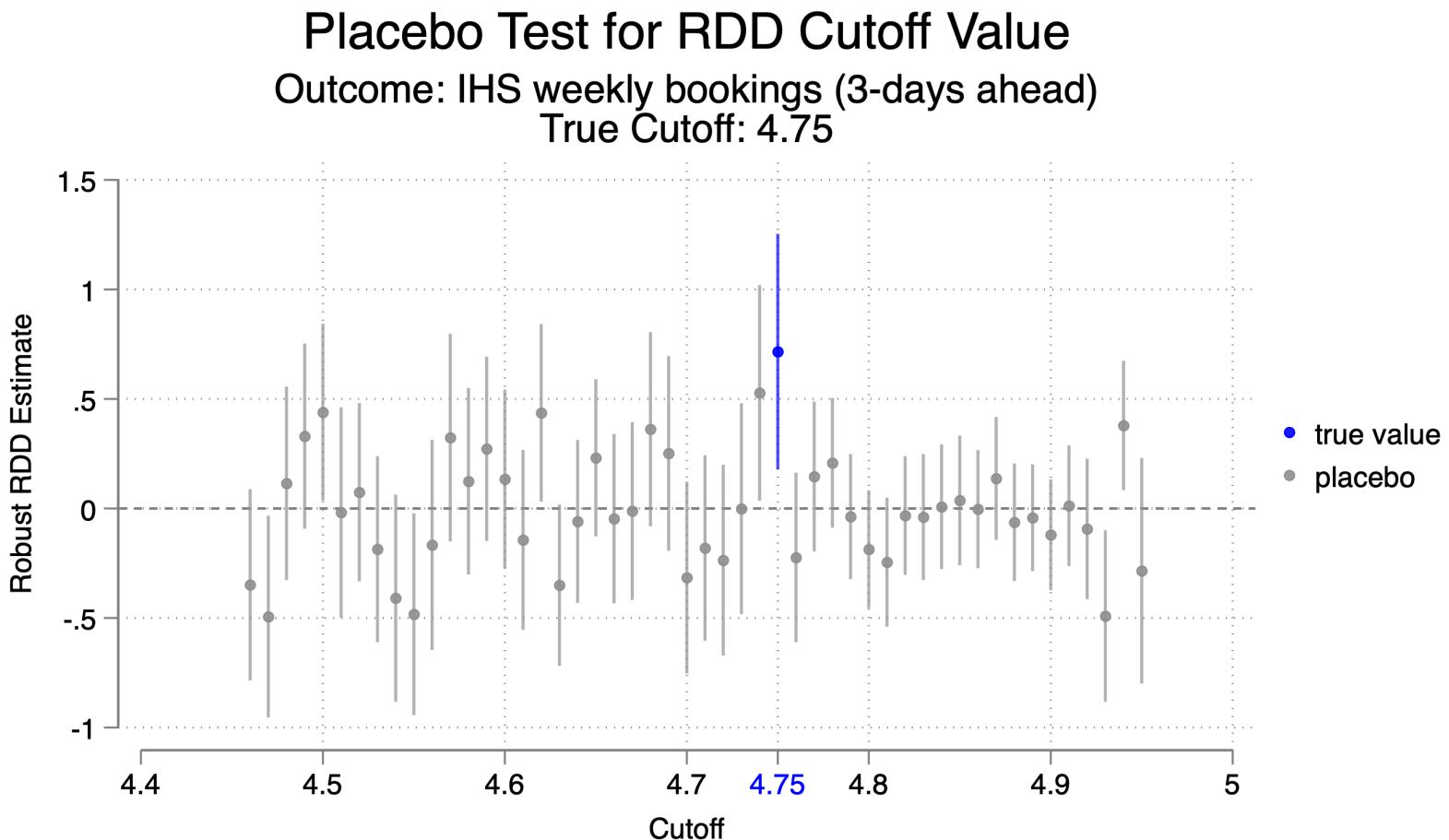
## RD Estimates for 5-Stars on Booking by Hospital Affiliation

Outcome: IHS weekly bookings (3-days ahead)  
Cutoff: 4.75



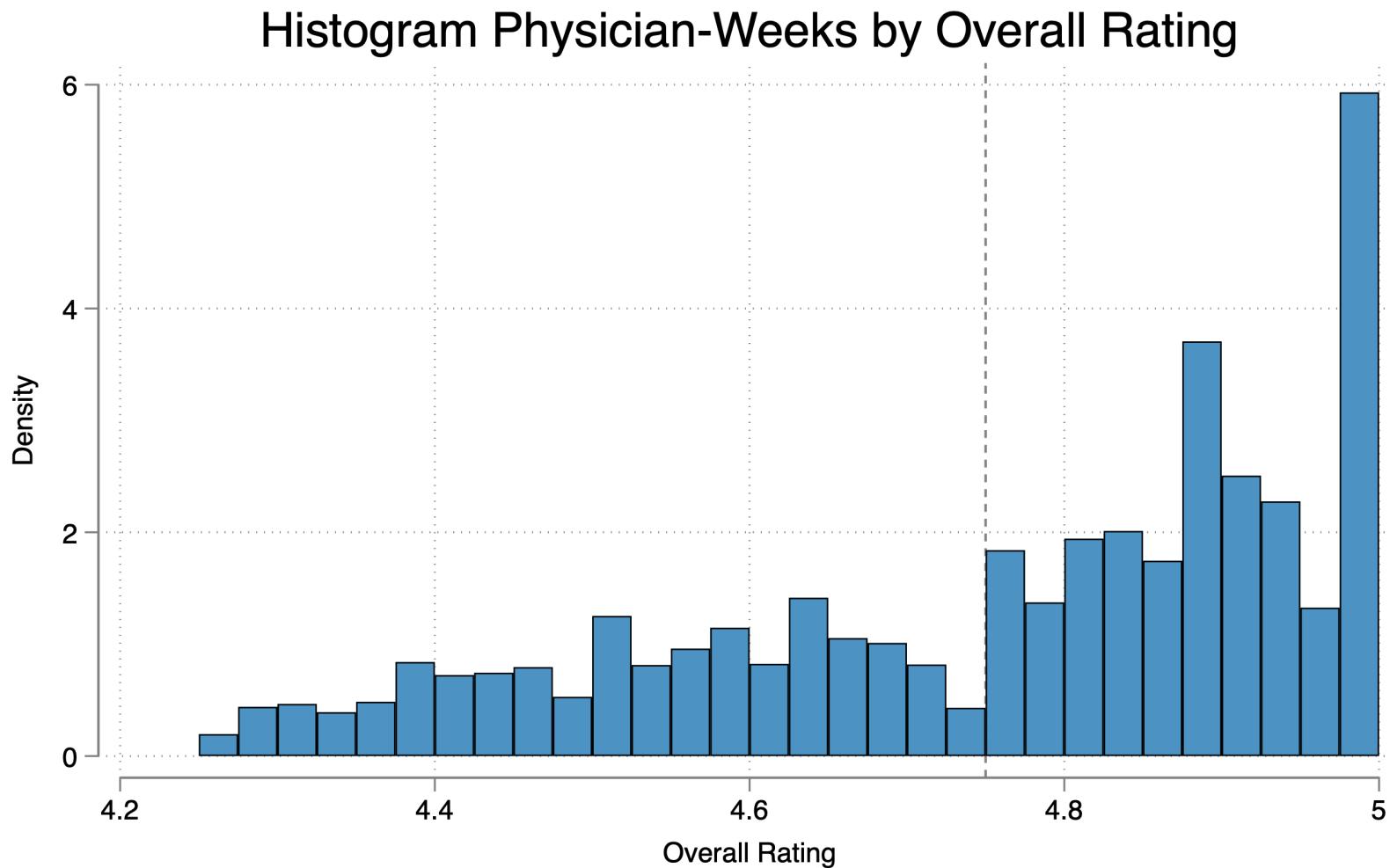
Controls: market-week, no. locations, appt length, appt type, no. reviews, hospital affiliation, offered appts  
Sample: 2/24/2016-4/17/2017, primary care, with appts offered during business hours 21 days in advance,  
stable ratings, excludes profiles with >4 rating removals  
Specification: data-driven asymmetric bandwidth, triangular kernel, NNcluster on physician

# Robustness: Placebo Test of Main Result



Controls: market-week, no. locations, appt length, appt type, no. reviews, hospital affiliation  
Sample: 2/24/2016-4/17/2017, primary care, min 8 ratings, with appts offered during business hours 21 days in advance,  
stable ratings, excludes profiles with >4 rating removals  
Specification: data-driven asymmetric bandwidth, triangular kernel, NNcluster on physician

# Robustness: Visible Bunching Above Cutoff



Sample: 2/24/2016-4/17/2017, primary care, min 8 ratings, with apts offered during business hours 21 days in advance,

# Conclusion

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SUMMARY OF RESULTS

DISCUSSION & MECHANISMS

# Summary of Findings

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## Descriptive Evidence

- Booking likelihood: More likely to be booked
- Booking speed: Booked further in advance

## Regression Discontinuity at 5-Stars

- Patient volume via bookings: Approx. twice as many bookings
- Patient volume via vacancies: Approx. half as many vacancies

## Differential Impact

- Physician gender: Effect greatest for women physicians
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## Robustness

- Placebo tests: Effect greatest at true cutoff
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# Discussion: Potential Mechanisms

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Gender: Effect greatest for women physicians

- But not closing a gender gap
- Correlated preferences
  - Ex: Gender, rating, and wait time
- Platform recommendation system

Ratings: Effect increases with number of ratings

- Consistent with Bayesian learning

Hospital Affiliation: Similar Effects

# Next Steps

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Extend to analysis to other cutoffs

Differential impact by apparent race and age

Robustness

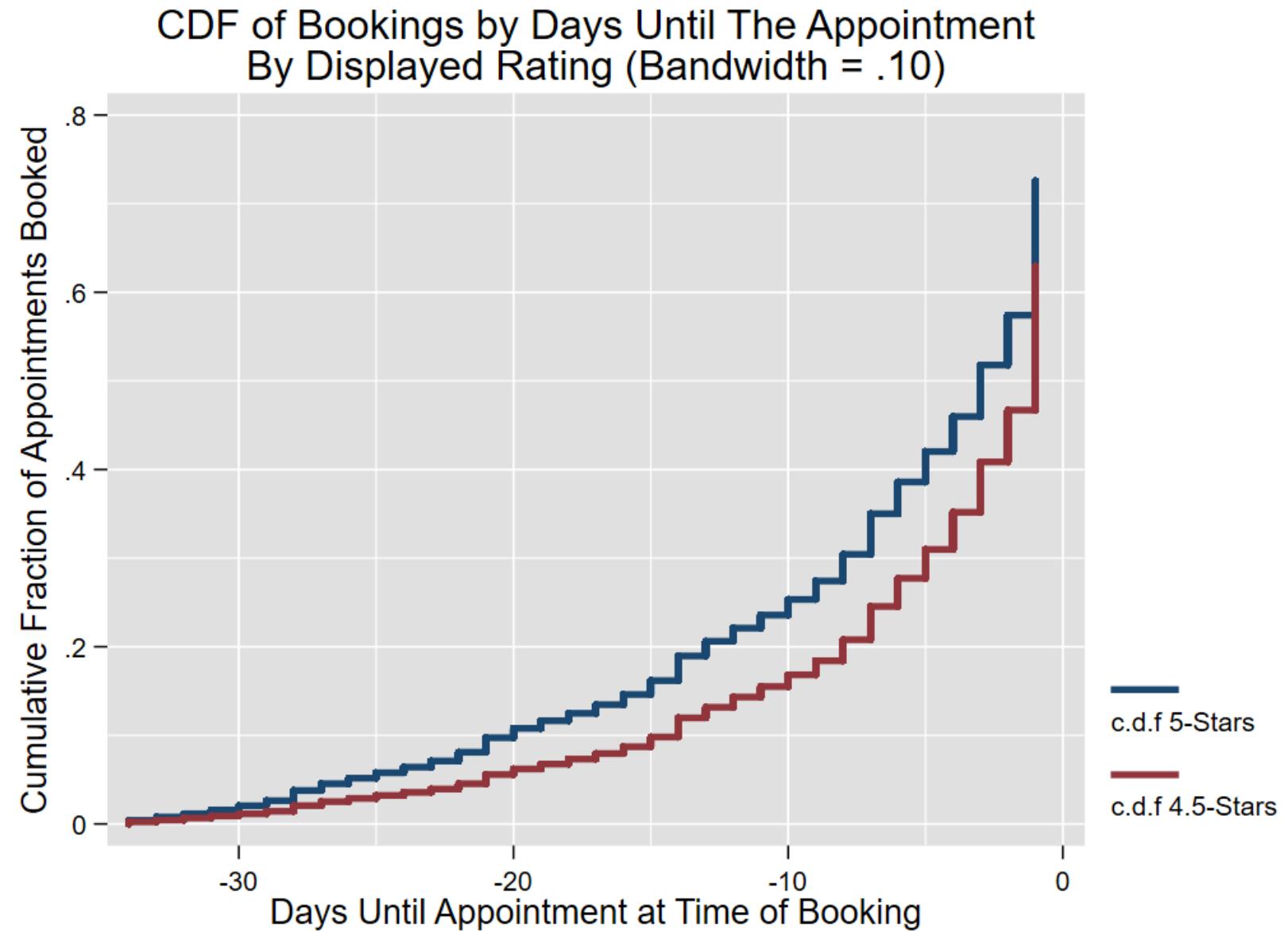
- Mass at cutoff
  - “Donut” regression discontinuity
- Covariate balance

# Appendix

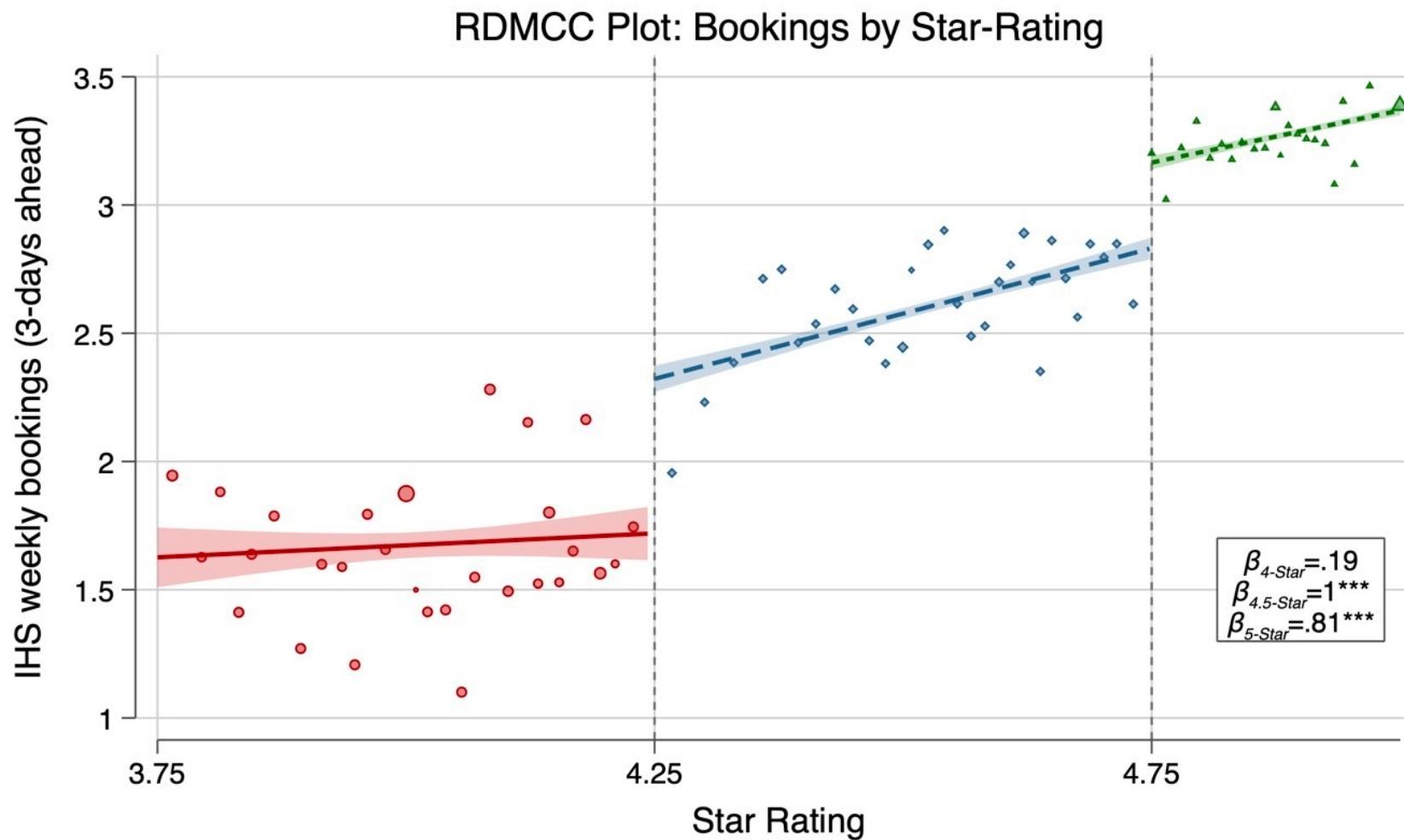
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## Booking by Time (CDF Comparison)

Use a pilot bandwidth of .1  
to compare these cdfs of  
physicians just above and  
just below the 4.75  
threshold to have five stars.



# Patient Volume by Star Rating: 4, 4.5, and 5-Stars



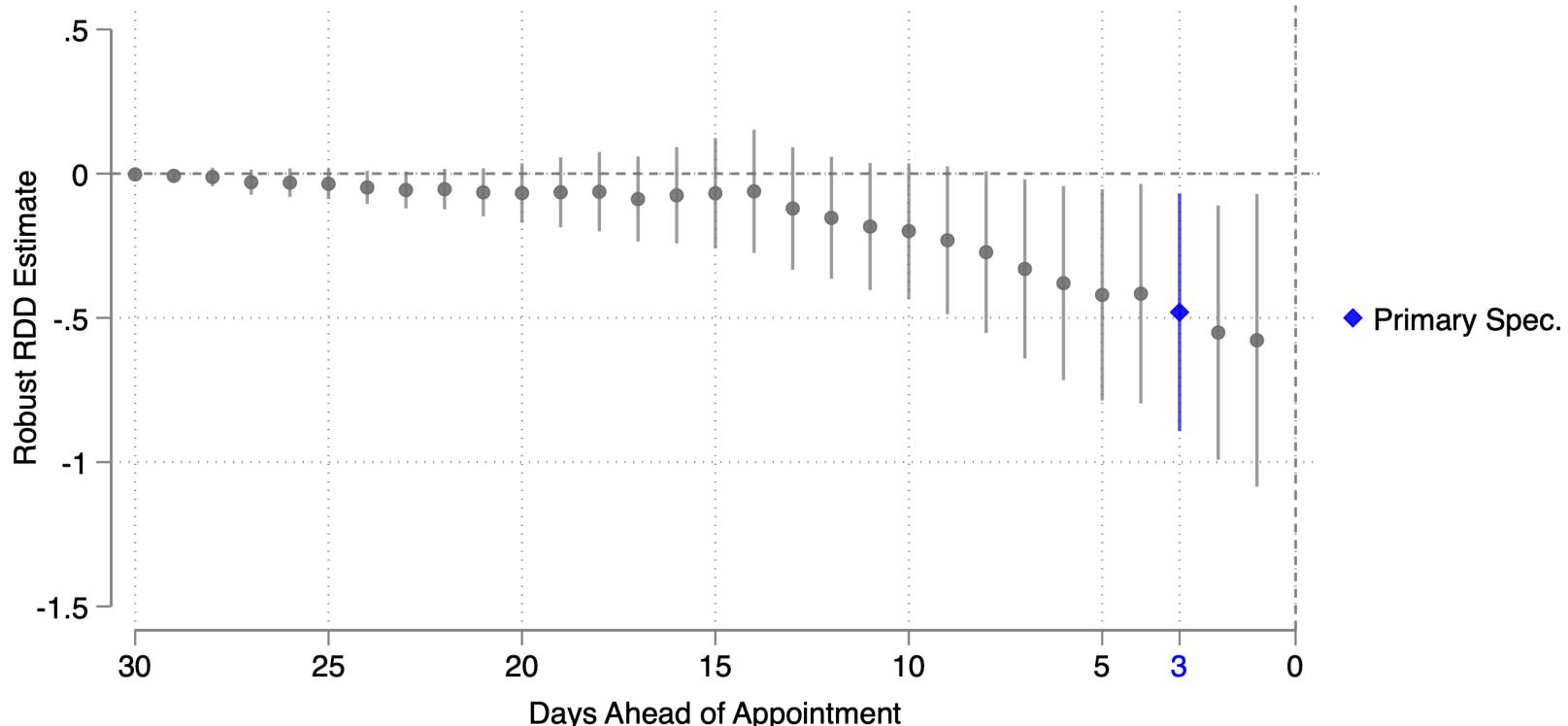
Controls: market-week, no. locations, appt length, appt type, no. reviews, hospital affiliation  
Sample: 2/24/2016-4/17/2017, primary care, min 8 ratings, with appts offered during business hours 21 days in advance, stable ratings, excludes profiles with >4 rating removals

5-star Results

# Impact of Ratings on Patient Volume: Fewer Vacancies

RDD: Remaining Vacant Appointments by Days Ahead of Appt.

Outcome: IHS Remaining Vacant Appointments  
True Cutoff: 5-Star



Controls: market-week, no. locations, appt length, appt type, no. reviews, hospital affiliation  
Sample: 2/24/2016-4/17/2017, primary care, min 8 ratings, with appts offered during business hours 21 days in advance, stable ratings, excludes profiles with >4 rating removals  
Specification: data-driven asymmetric bandwidth, triangular kernel, NNcluster on physician

Booking Results

# Booked Appointments by Page Rank Proxy

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We are also interested in platform mechanics. Here, we take advantage of the fact that page rank is a function of availability.

**Observation Level:** Physician-day

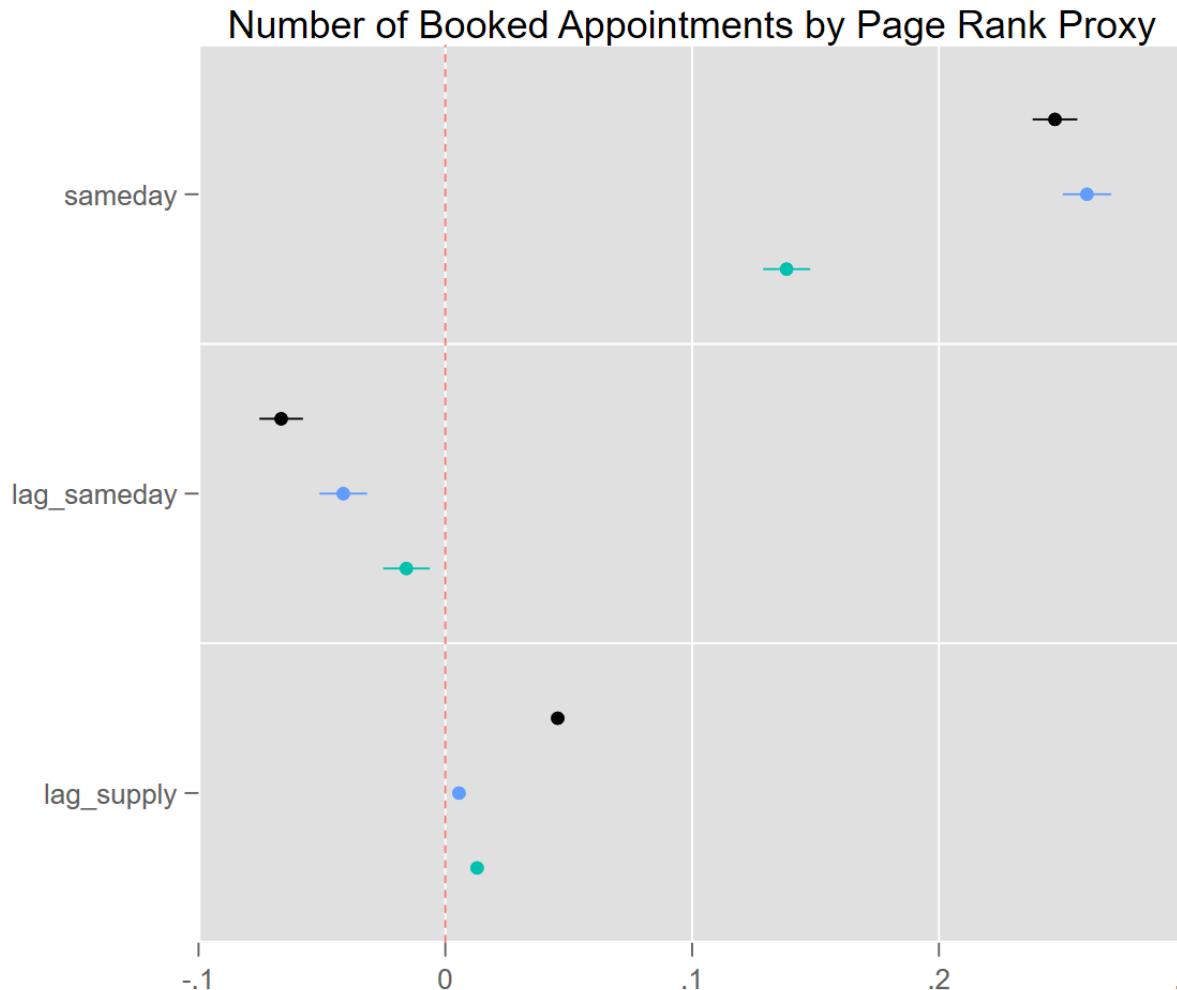
**Dependent Variable:** Count of appointments booked that day

**Variables of Interest:** Proxy for page rank with the number of same day appointments available, and the lag of same day appointments available.

**Intuition:** If page rank has no effect, we might expect these coefficients to be negative. A positive coefficient suggest page rank is indeed important.

**Controls:** Number of available appointments, physician FE, and time FE.

# Booked Appointments by Page Rank Proxy



	(1) booked	(2) booked	(3) booked
Same Day	0.247*** (53.49)	0.260*** (52.12)	0.138*** (28.31)
Lag Same Day	-0.0665*** (-14.78)	-0.0413*** (-8.38)	-0.0158** (-3.28)
Lag Supply	0.0455*** (45.60)	0.00554*** (5.56)	0.0129*** (11.76)
<i>N</i>	487408	487408	487408
<i>R</i> <sup>2</sup>	0.012	0.006	0.186
<i>Physician FE</i>		X	X
<i>Time FE</i>			X

- Specificaion
- OLS
  - Physician FE
  - Time & Physician FE