The Effects of Temporal Distance on Communication Patterns: Evidence from Daylight Savings Time



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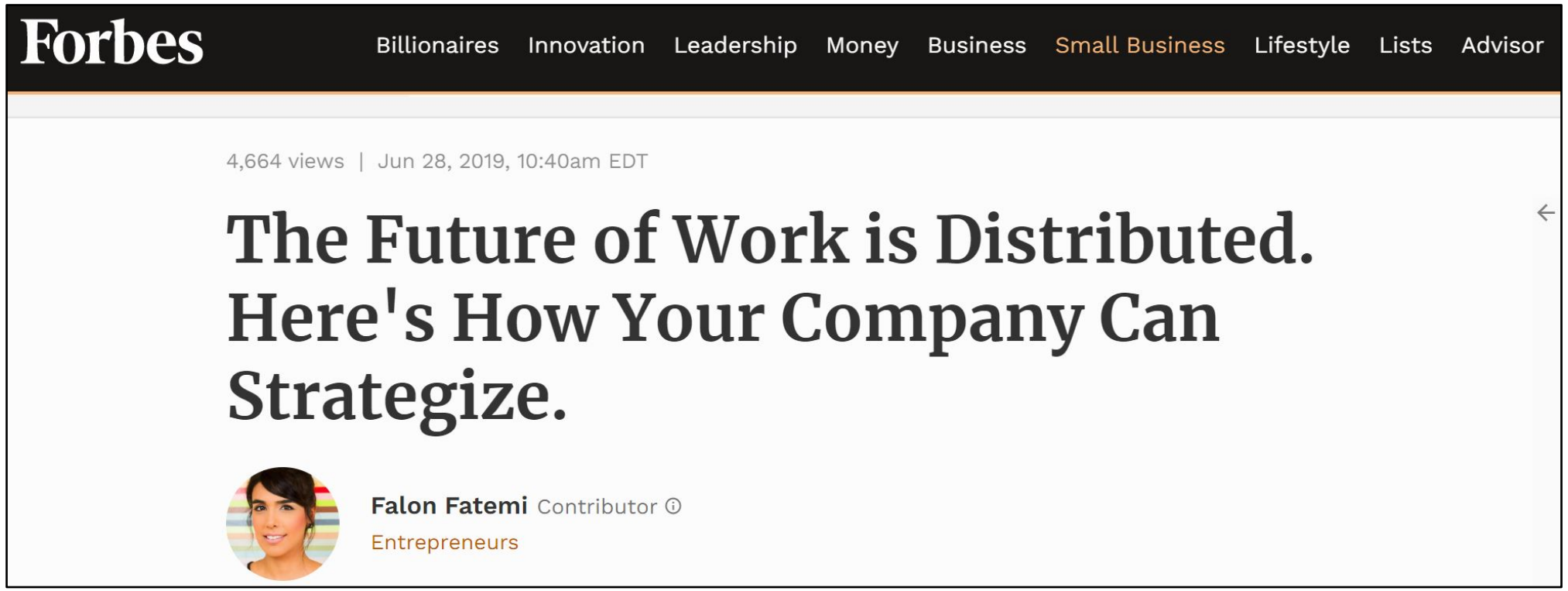
Geographically distributed work is on the rise



Source: https://www.forbes.com/sites/falonfatemi/2019/06/28/the-future-of-work-is-distributed-heres-how-your-company-can-strategize/#662e4154193d

Related literature

- Communication is *the* primary mechanism for coordinating geographically distributed work and transferring knowledge (Ghoshal, Korine, & Szulanski, 1994; Gupta & Govindarajan, 2000; Srikanth & Puranam, 2011; Mani, Srikanth, & Bharadwaj, 2014)
- Advances in ICT have drastically reduced communication costs (Forman & Zeebroek 2015) and enabled the offshoring of increasingly complex work (Branstetter, Glennon, & Jensen, 2018; Kerr & Kerr, 2018)
- However, frictions associated with multiple dimensions of distance remain (Alcácer et al., 2017, Ghemawat, 2011; Berry et al., 2010; Olson & Olson 2000)
- **We shed light on the frictions created by one relatively understudied dimension of distance: temporal distance**

Research question

To what extent and how does temporal distance affect communication among spatially distributed collaborators?

This paper

- Daylight savings time (DST) as a natural experiment
  - Dif-in-dif research design compares communication patterns for office pairs that gained or lost business hour overlap (BHO) with office pairs whose overlap remained unchanged
  - BHO measures shared hours from 8 am to 6 pm (O'Leary & Cummings, 2007; Bøler, Javorcik, Ulltveit-Moe, 2018)
- Measured outcomes
  - Volume of inter-office communication by mode (scheduled calls and meetings, unscheduled calls, instant message (IM) chats, e-mail)
  - Volume of inter-office communication by employee function (R&D, IT, production, other)

Preview of results

- Temporal distance affects volumes of **synchronous communication**
  - More BHO leads to more *unscheduled* communication (22 percent increase, on average)
  - Less BHO leads to less scheduled and unscheduled communication (roughly 6-8 percent, on average)
- Significant **heterogeneity by function** of the employee
  - Positive reposes to increased proximity fully driven by global R&D workers
  - Negative responses concentrated in operational workers (production and IT)
- Effects on **asynchronous communication** (e-mail) mixed
  - Some evidence that e-mail complements rather than substitutes for synchronous communication

Talk Outline

1. Theoretical Background
2. Data & Descriptive Patterns
3. Empirical Strategy and Results
4. Conclusion

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1. **Theoretical Background**
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Theories of Mediated Communication

- Effectiveness of communication depends not only on volume but also *richness* (Daft & Lengel, 1986; Hinds and Kiesler, 1995; Dennis, Fuller, & Valacich, 2008)
  - Richness is "*The ability of information to change understanding within a time interval*" or "*learning capacity of a communication*"(Daft & Lengel, p. 560)

Synchronous  **Asynchronous**

- Richer
- Better suited for reduction of ambiguity
- Helps to create trust and shared understanding

- Leaner
- More efficient at transmitting large amounts of unequivocal information

- Most collaborations involve *both*, albeit in different amounts

The Role of Temporal Distance

- Temporal distance ***increases the cost*** of synchronous communication
  - Fewer opportunities to communicate during the work day
  - Communication can shift to outside of business hours but at a higher opportunity cost
- ***Knowledge-intensive work*** has high returns to synchronous and spontaneous communication (e.g., Allen 1977; Catalini 2017)
  - Knowledge-intensive collaborators may be more willing to bear the higher cost of working outside business hours
- Temporal distance has theoretically ambiguous effects on asynchronous communication
  - May substitute, complement, or even be orthogonal to synchronous communication

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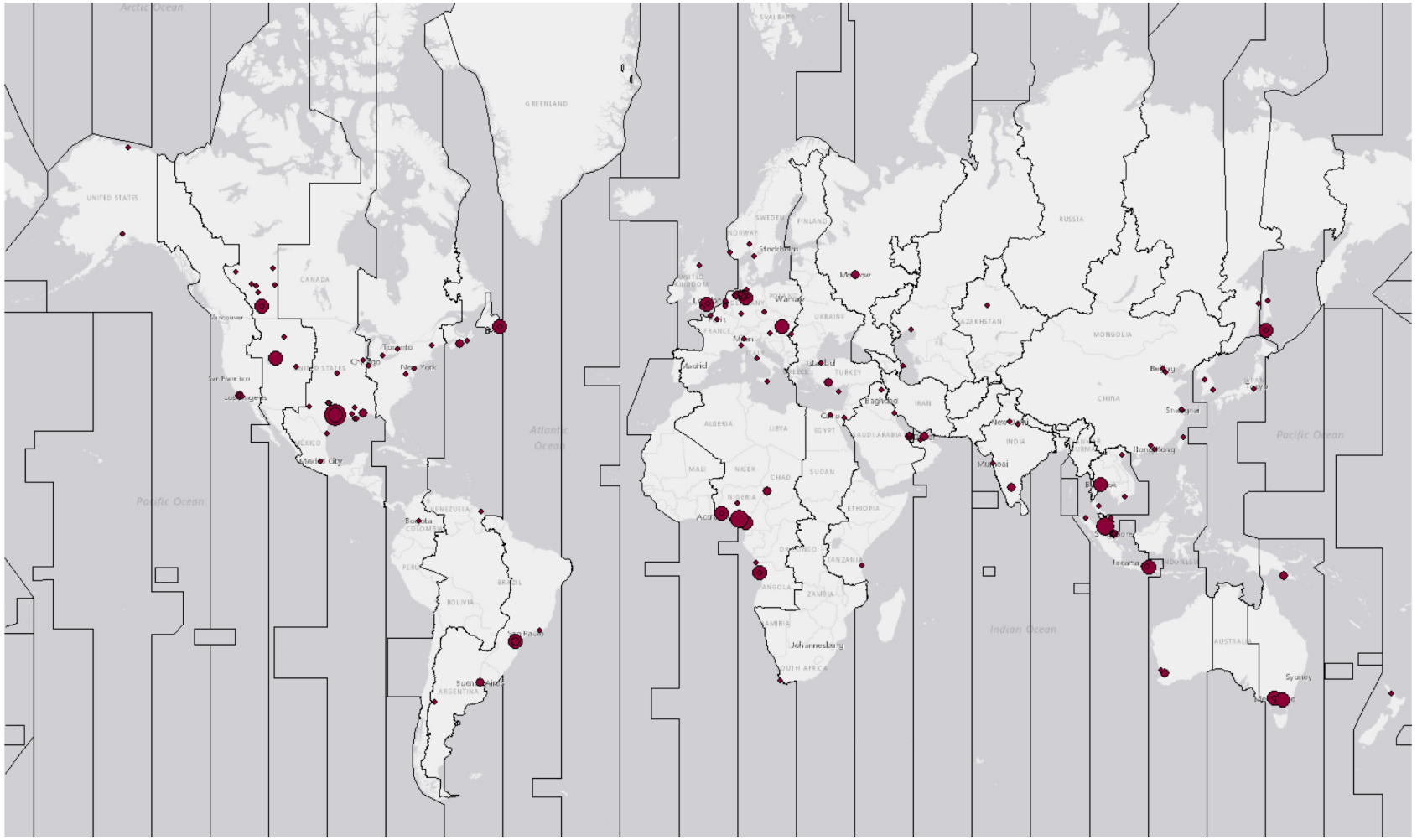
Data and Empirical Context

- A *Fortune 100* multinational company (largest division)
  - 253 offices across 48 countries
- Employee communication records for a 12-week period in the Fall of 2017
  - Sample of 12,089 employees with location (city) and function (R&D, IT, production, other) data
  - Daily communication minutes for **three synchronous** and **one asynchronous** communication medium

1. Scheduled Calls and Meetings
2. E-Mail

3. Unscheduled Calls
4. Instant Message Chats

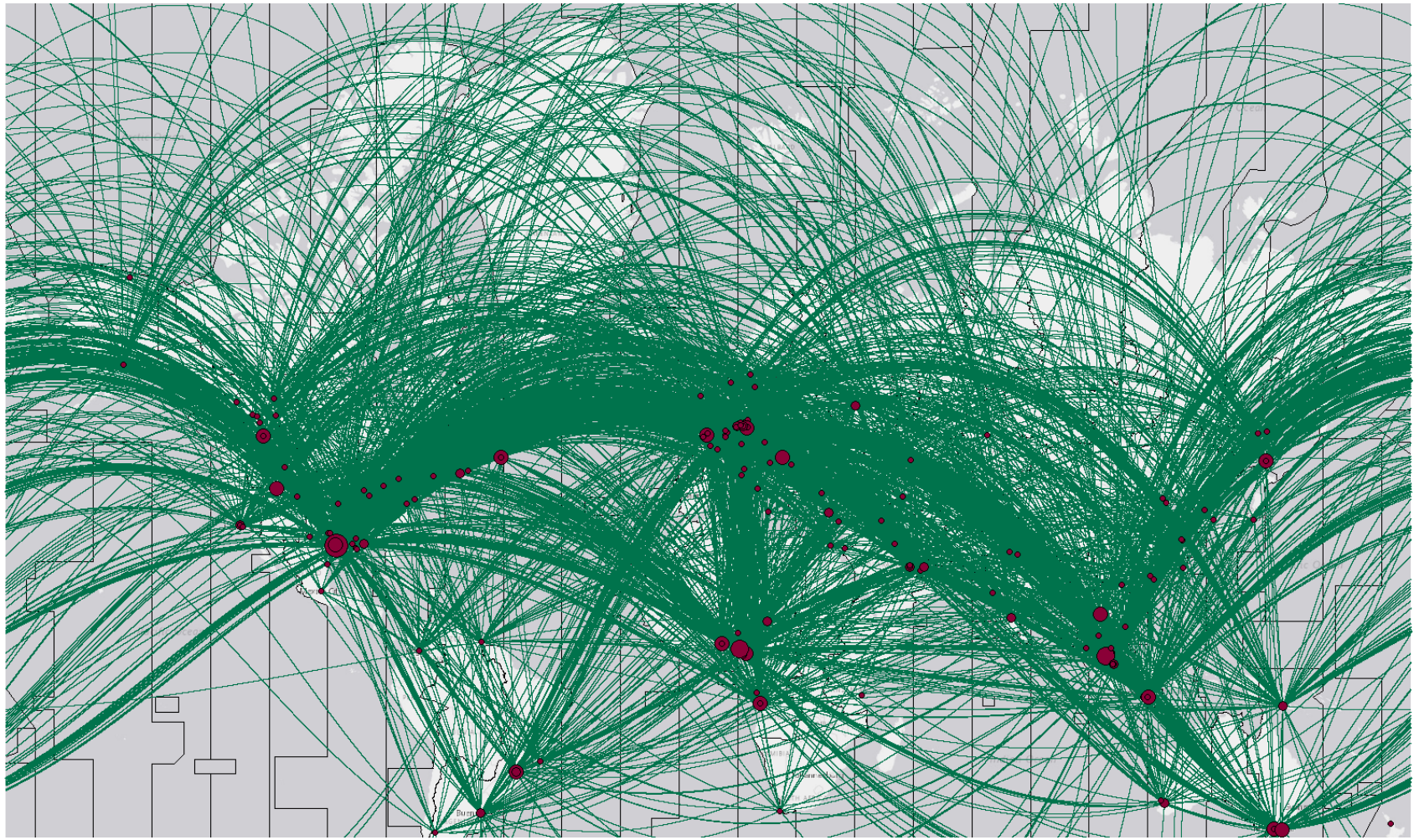
Employee Locations



Note: Each node represents one of 253 Division offices and is weighted by the number of employees.

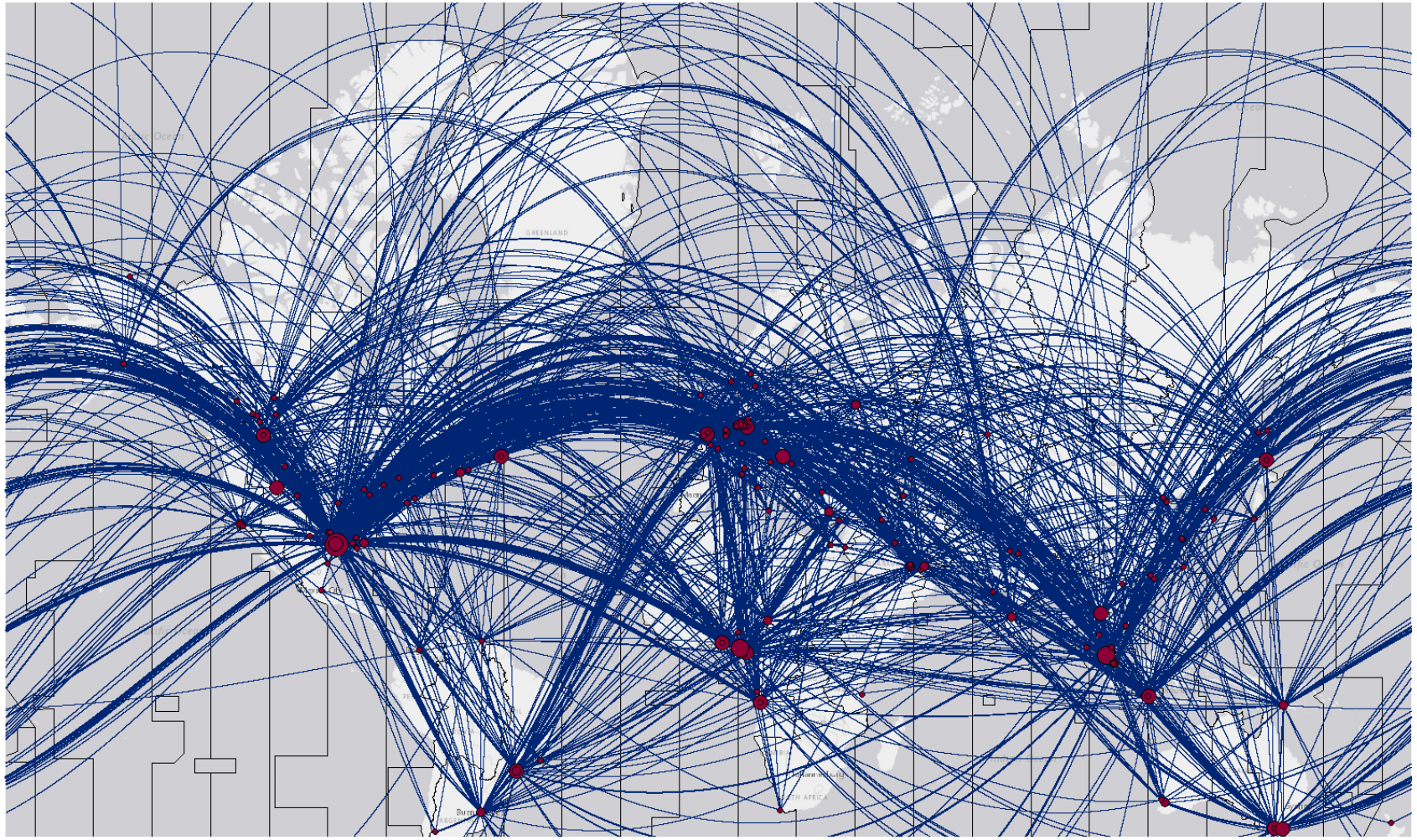
Employee Detail

Synchronous Communication Flows (80%)



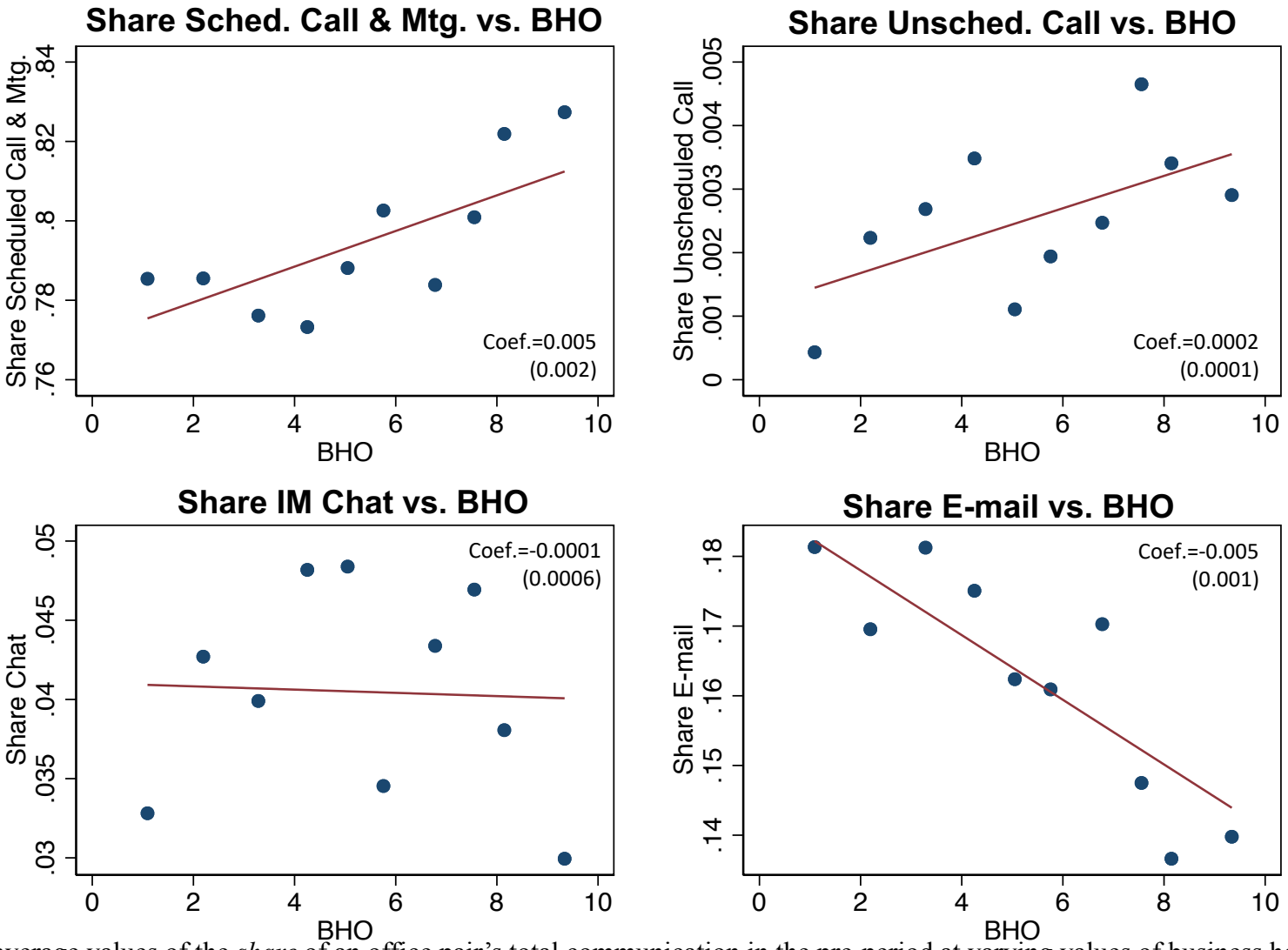
Note: Each node represents one of 253 Division offices and is weighted by the number of employees. Each link represents the volume of synchronous communication (unscheduled calls, scheduled calls & meetings, and instant message chats) in the pre-period between the office pair, with link width proportional to communication volume.

Asynchronous Communication Flows (20%)



Note: Each node represents one of 253 Division offices and is weighted by the number of employees. Each link represents the volume of synchronous communication (e-mail) in the pre-period between the office pair, with link width proportional to communication volume.

Descriptive Patterns



Note: Binned scatterplots show the average values of the *share* of an office pair's total communication in the pre-period at varying values of business hour overlap by media type. Models control for geographic distance between office pairs (in logs) and total office pair communication volume (in logs). Observations are all office pairs with non-zero total communication in the pre-period.

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Empirical Strategy

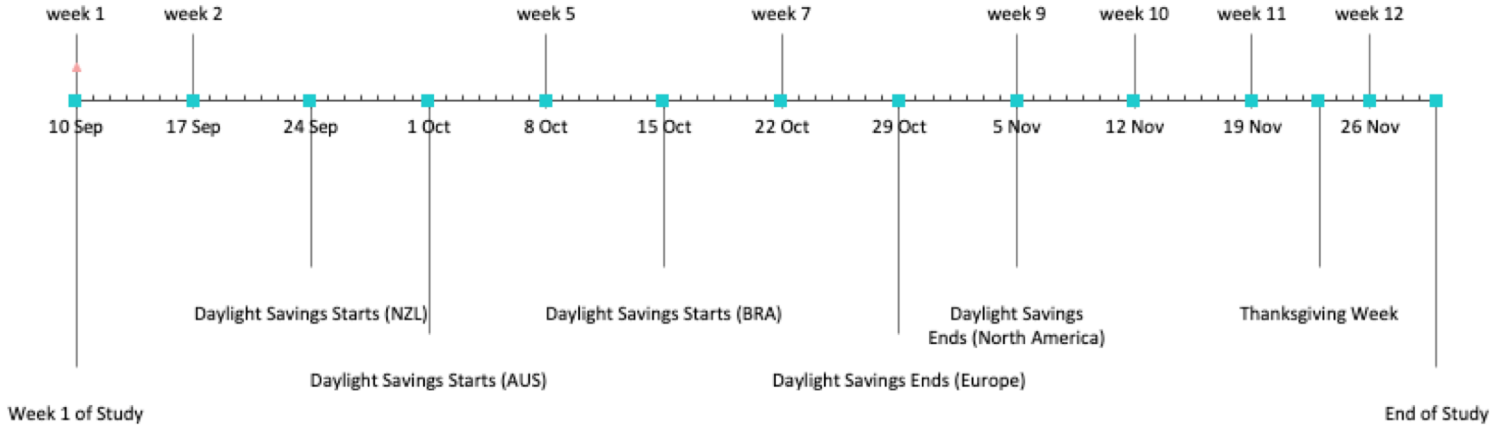
- Natural experiment based on countries' moves to/from DST in the fall of 2017

Houston

São Paulo

Bangalore

Timeline of events



Treatment Detail

Dyad-week level specification

$$Comm_{ijt} = exp\left[\beta_0 + \beta_1 T_{ij} * Post_t + \beta_2 Post_t + \beta_3 C'_{it} + \beta_4 C'_{jt} + d_{ij} + \partial_t\right] \varepsilon_{ijt}$$

Where:

- $Comm_{ijt}$ = Total employee communication (in minutes) for office pair ij in week t
- T_{ij} = Treatement status of office pair ij (1 if $Increased\_BHO$=1 or $Decreased\_BHO$=1, respectively)
- $Post_t$ = Earlier of weeks after office location moves to/from DST or weeks after Nov. 5
- C'_{it} = Office-week level controls
- d_{ij} = Office pair fixed effects
- ∂_t = Week fixed effects

- Estimated with gravity-style PPML models (Silva & Tenreyro, 2006) separately for positively and negatively treated dyads and for each communication mode

Increased BHO & Communication volume, by medium

	(1)	(2)	(3)	(4)
	Synchronous			Asynchronous
	Scheduled Call & Mtg.	Unscheduled Call	Inst. Message Chat	E-mail
Increased BHO x Post	-0.008	0.222*	0.077	0.047*
	(0.095)	(0.115)	(0.067)	(0.027)
Controls	Y	Y	Y	Y
Dyad FE	Y	Y	Y	Y
Week FE	Y	Y	Y	Y
Model	Poisson	Poisson	Poisson	Poisson
Dyads	4,369	515	1,365	2,352
Dyad-Weeks (N)	52,428	6,180	16,380	28,224

Note: Dependent variables are weekly attention minutes. The number of dyads in each case corresponds to the office pairs that have non-zero and time-varying values of communication in each communication type. Estimation using Poisson Pseudo Maximum Likelihood model. Controls include the weekly communication volumes for each office minus the focal communication in a dyad-week, as well as dyad and week fixed effects. *Post* dummy not reported. Standard errors clustered at the dyad-level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Pre-trends

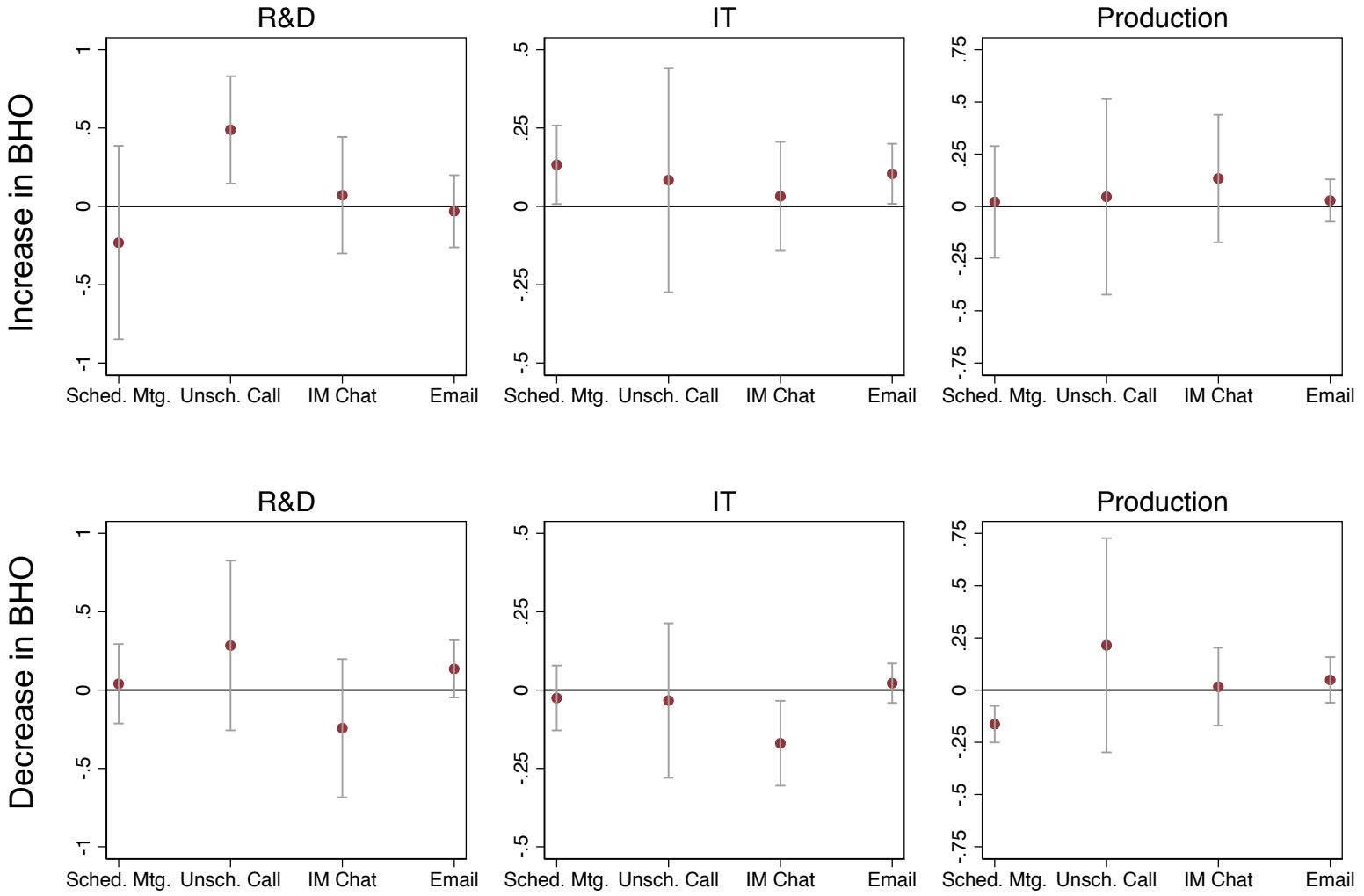
Decreased BHO & Communication volume, by medium

	(1)	(2)	(3)	(4)
	Synchronous			Asynchronous
	Scheduled Call & Mtg.	Unscheduled Call	Inst. Message Chat	E-mail
Decreased BHO x Post	-0.065**	-0.024	-0.083*	0.027
	(0.030)	(0.091)	(0.048)	(0.026)
Controls	Y	Y	Y	Y
Dyad FE	Y	Y	Y	Y
Week FE	Y	Y	Y	Y
Model	Poisson	Poisson	Poisson	Poisson
Dyads	5,292	599	1,570	2,781
Dyad-Weeks (N)	63,504	7,188	18,840	33,372

Note: Dependent variables are weekly attention minutes. The number of dyads in each case corresponds to the office pairs that have non-zero and time-varying values of communication in each communication type. Estimation using Poisson Pseudo Maximum Likelihood model. Controls include the weekly communication volumes for each office minus the focal communication in a dyad-week, as well as dyad and week fixed effects. *Post* dummy not reported. Standard errors clustered at the dyad-level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Pre-trends

Effects by employee function



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Conclusion

- To our knowledge, first causal estimate of effect of temporal distance on intra-firm communication
- Results suggest that
  - Knowledge-intensive employees (R&D) place high value on temporal proximity and unscheduled, synchronous communication
  - Operational employees (production & IT) more likely to decrease synchronous communication in response to temporal distance
  - Asynchronous communication (e-mail) may complement rather than substitute for synchronous communication
- Strategic implications for the spatial organization of firms and offshoring of work
  - When “follow the sun” arrangements vs. North-South arrangements may be more effective

Thank You!

Comments / Questions?

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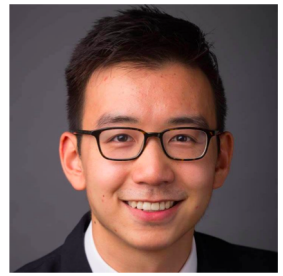

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Appendix

- Supplementary slides
- References

Employee Detail

In-Sample Employees by Office Location (left) and by Function (right)

Office Location	Total	*Percent*
North America	4,883	40.4
Asia Pacific	2,646	21.9
Middle East / Africa	2,191	18.1
Europe	1,845	15.3
Central/ South America	524	4.3
Total	12,089	100.0

Function	Total	Percent
Production	6,648	55.0
IT	2,188	18.1
R&D	1,754	14.5
Other*	1,499	12.4
Total	12,089	100.0

Note: "Other" group includes more than 20 smaller functions.

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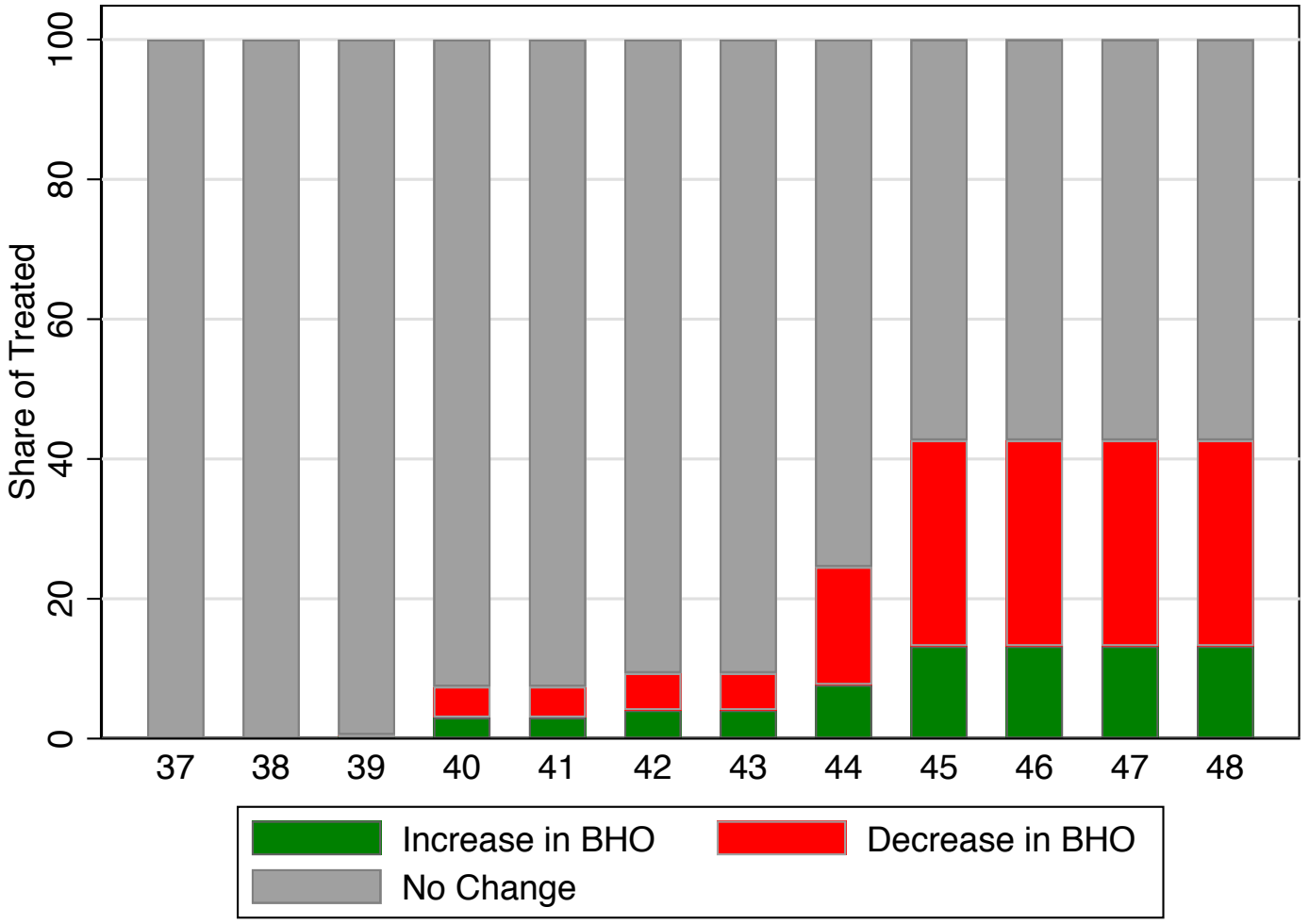
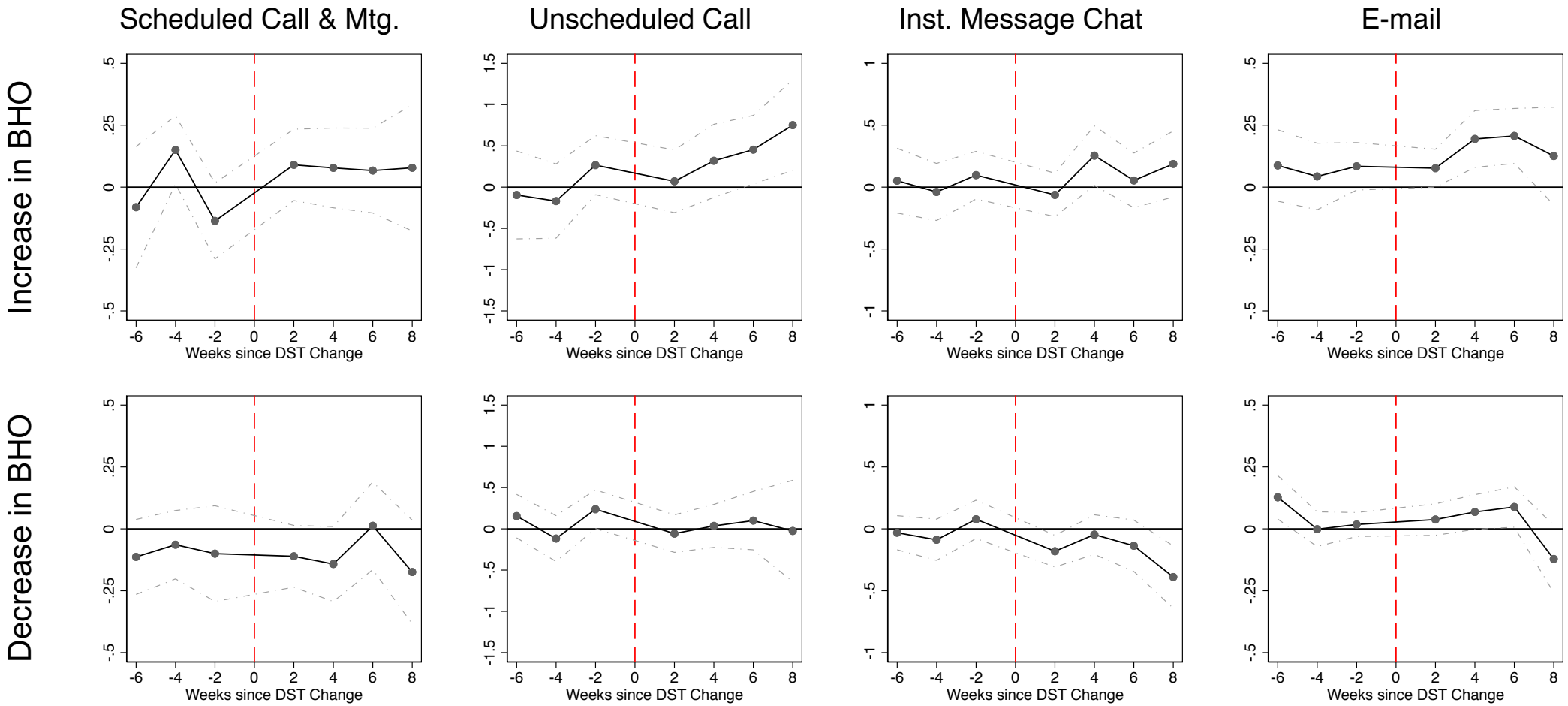
Distribution of Treatment



Absence of Pre-trends



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