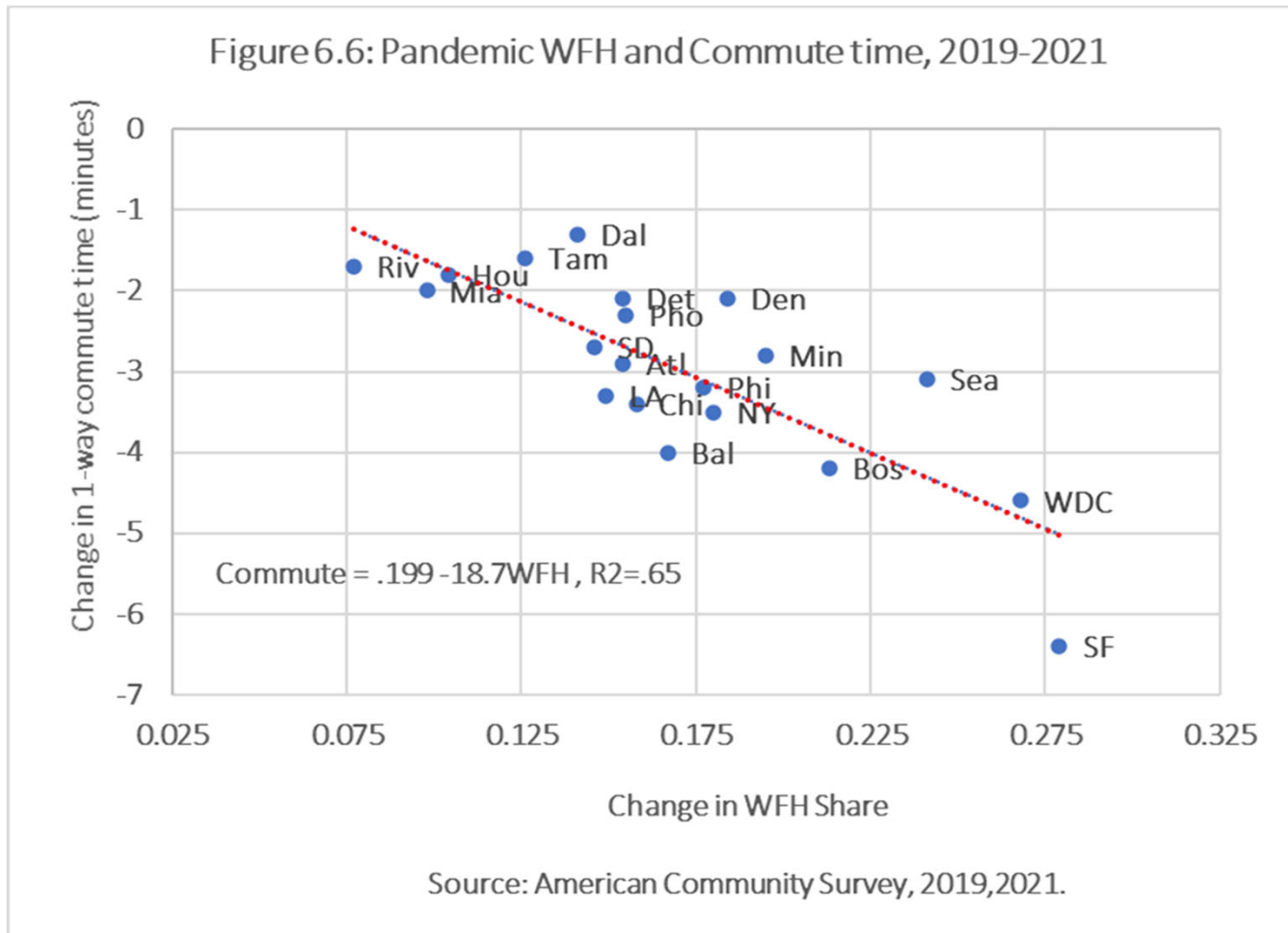


Work From Home: Commuting and Productivity within Cities

Presented by
William Wheaton (CRE, MIT)
with
Sadi Sabouri (SCL, MIT)

Figure 1: Recent WFH impacts on Cities: Less commuting, congestion, Flatter rents, prices



DiPasquale & Wheaton
(2025)

Existing WFH research

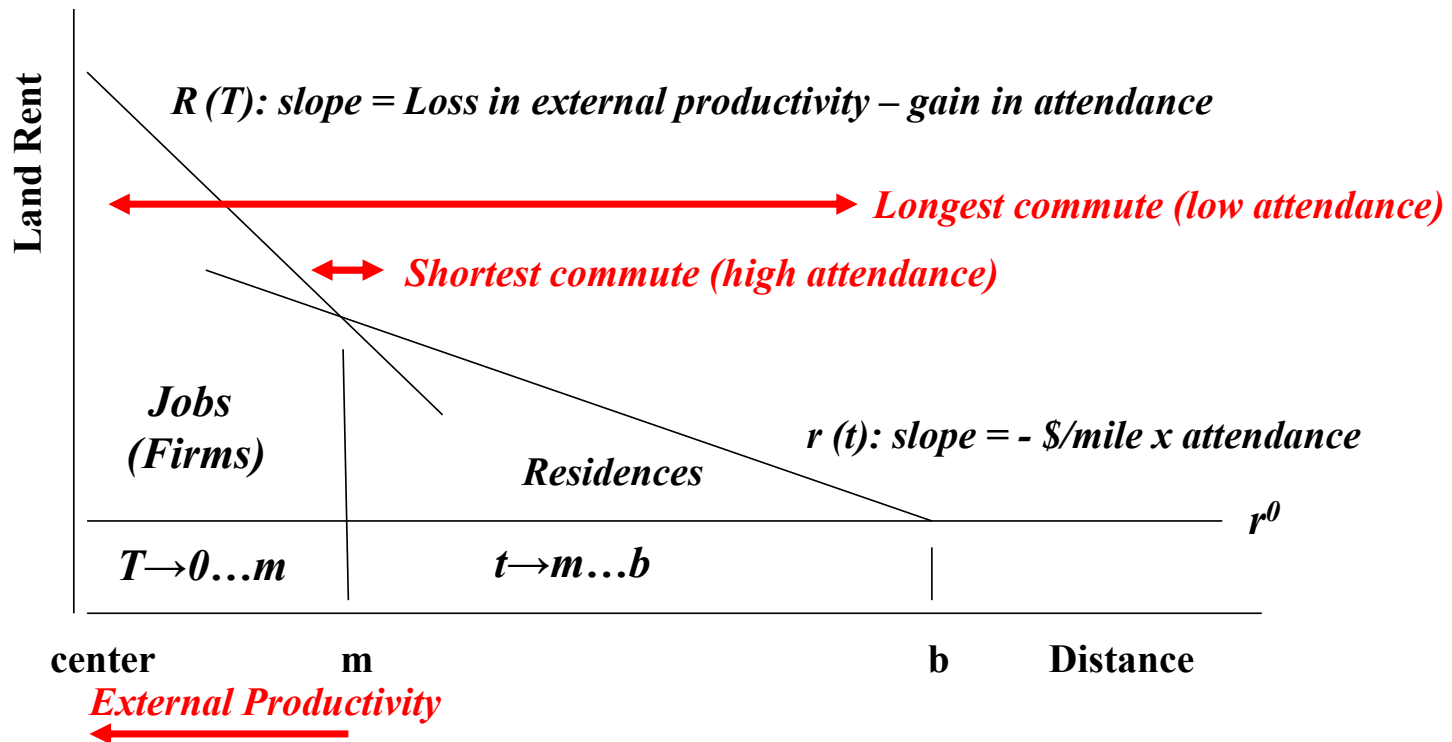
- WFH concentrated in select occupation/industries: White Collar... surveys pre-post Covid: Dingel-Neiman (2020), APBGR, (2020)
- Longer term upward trend pre-Covid: Autor (2022), BLS (2016, 2023)
- Productivity case studies: Cullen (2025), Gibbs (2021)
- “Flattening” of MSA house price gradient from less traffic, lower commute costs: Bloom(2021), Gupta (2022), Delventha (2022), Kim (2023). Overall housing demand increases: Davis (2025). WFH needs a home to work from!
- “Flattening” of commercial Price gradients: occupation mix raises CBD vacancy more than suburban: Rosenthal (2022), Rolheiser (2022).
- “Bifurcation Theory”, CBD productivity > commute cost when all work in CBD – then all choose CBD: When all WFH if CBD productivity < commute costs – all choose WFH. Monte, R-H (2023)

Modeling WFH within an Urban Area

Productivity (output/worker and wage) depends on 2 factors:

- 1). *External* firm agglomeration: which increases with greater proximity to other firms. Highest at CBD, lower in suburbs. The Classic Marshall externality.
- 2). *Internal* firm agglomeration: which is higher with greater attendance (less WFH) by firm workers (Mentoring, OJT...)
- 3). Worker attendance should be lower for those with longer commutes: trading WFH for less productivity (promotions, pay...)
- 4). Firms have greater incentive to move to suburbs: loose external productivity but now pick up internal productivity as shorter commutes boost worker attendance.
- 5). Ricardian Rent compensates everyone for everything.

Figure 2: Ricardian Rent for Firms (R) and household (r) in Model of commuting and WFH Choice (attendance)



Firms: output/worker (Q) and rent (R)

Distance to other firms

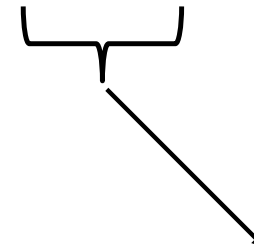
Worker attendance

$$Q(T, a): \frac{\partial Q}{\partial T} < 0, \quad \frac{\partial Q}{\partial a} > 0, \quad \frac{\partial^2 Q}{\partial a^2} < 0, \quad \frac{\partial^2 Q}{\partial a \partial T} < > 0$$

Compliments (<0)
Substitutes (>0)

$$R(T) = Q(T, a) + Q^0$$

$$dR/dT = \partial Q/\partial T + \underbrace{\partial Q/\partial a da/dT}$$



Workers: wages (output), commute costs and rent (r)

$$r(t) = Q(T, a) - ka(t - T) + r^0$$

$$\frac{\partial Q}{\partial a} - k(t - T) = 0$$

F.O.C. given t, T

$$\frac{da}{dt} = k / \frac{\partial^2 Q}{\partial a^2} < 0$$

$$\frac{da}{dT} = - \left[\frac{\partial^2 Q}{\partial a \partial T} + k \right] / \frac{\partial^2 Q}{\partial a^2} >< 0$$

**Separable, Substitutes
or Weak Compliments (>0)
Strong Compliments (<0)**

$$\frac{dr}{dt} = \frac{\partial r}{\partial t} = -ka < 0, \quad d^2r/dt^2 = -k da/dt > 0$$

WFH Model Empirical Propositions

When attendance is variable and chosen to be partial (as opposed to full and mandated) then:

(a) Attendance is lower for workers residing farther from their workplace.

(b) Attendance is higher at firms locating outward and generally closer to their workers' residences.

(c). Firm rent gradients becomes flatter with distance as greater worker attendance now helps to offset the loss of external agglomeration.

(d). Residential rent gradients also flatten as commute frequency drops.

Figure 2: Office Attendance in San Francisco: 90 Buildings
(Kastle Systems)

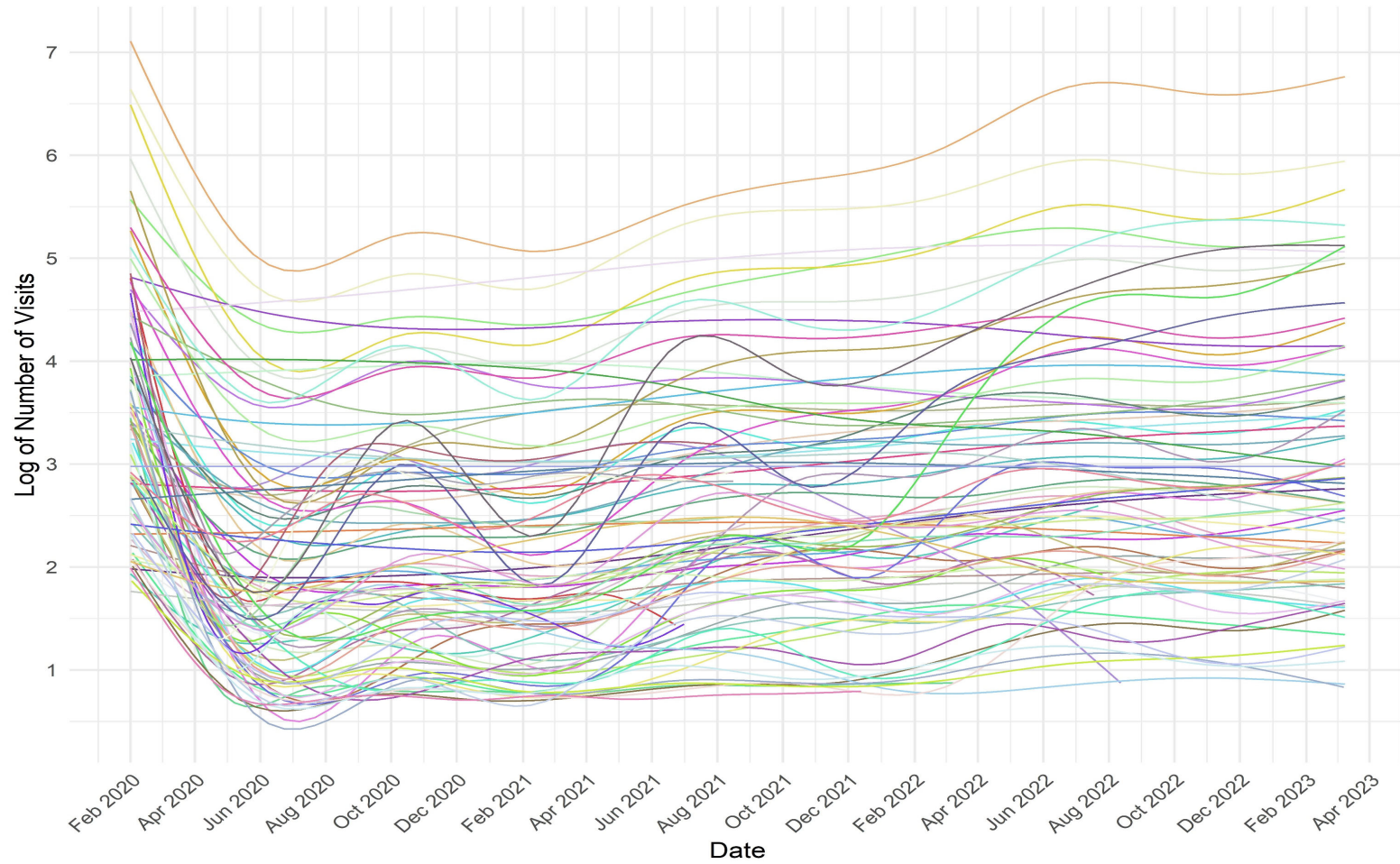


Figure 3: *Building Attendance Trends, 11 US Metros*
(Kastle Systems building tabulation)

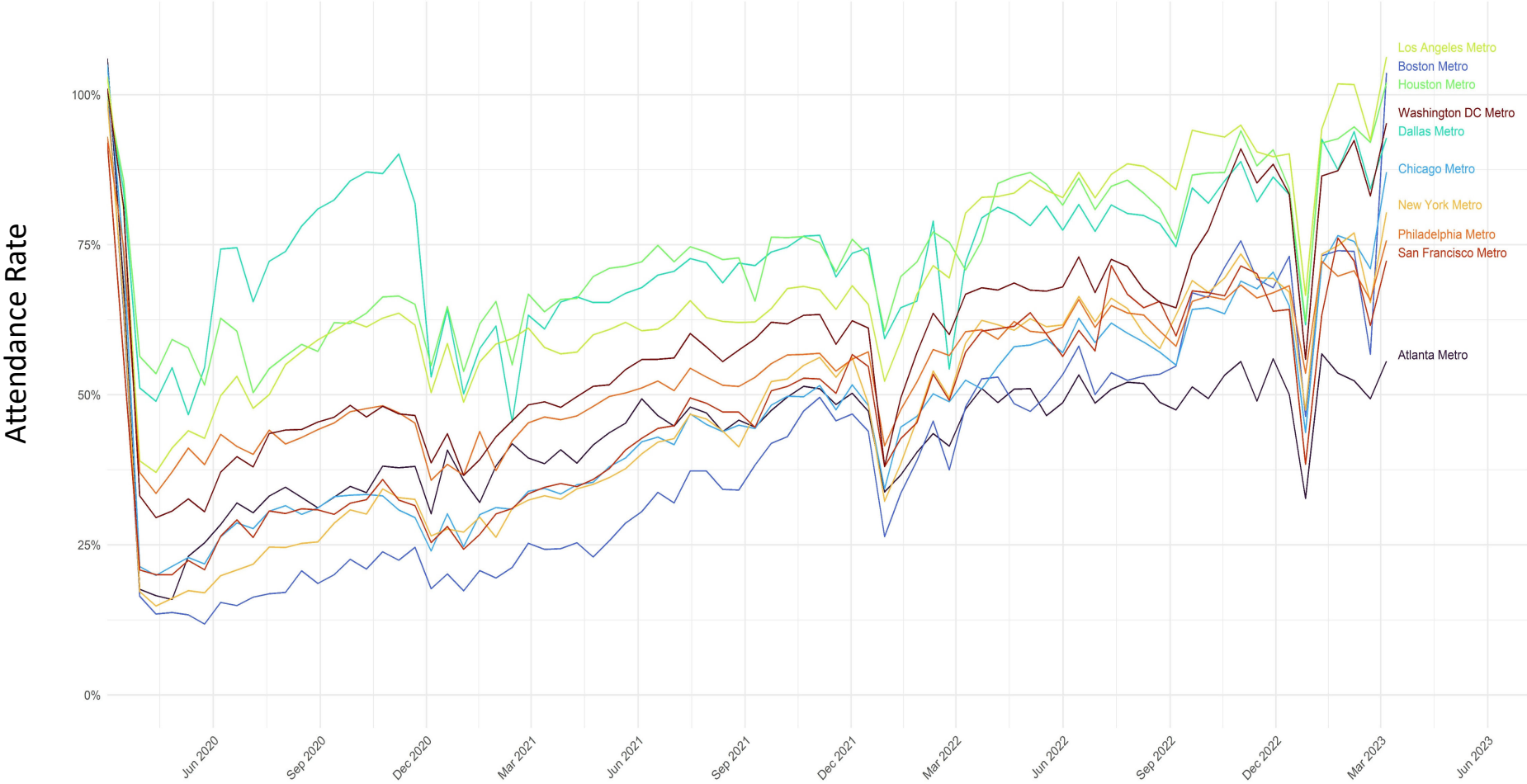


Figure 4: *Worker Attendance Trends, 11 US Metros*
(Weighted tabulation: larger buildings=lower attendance)

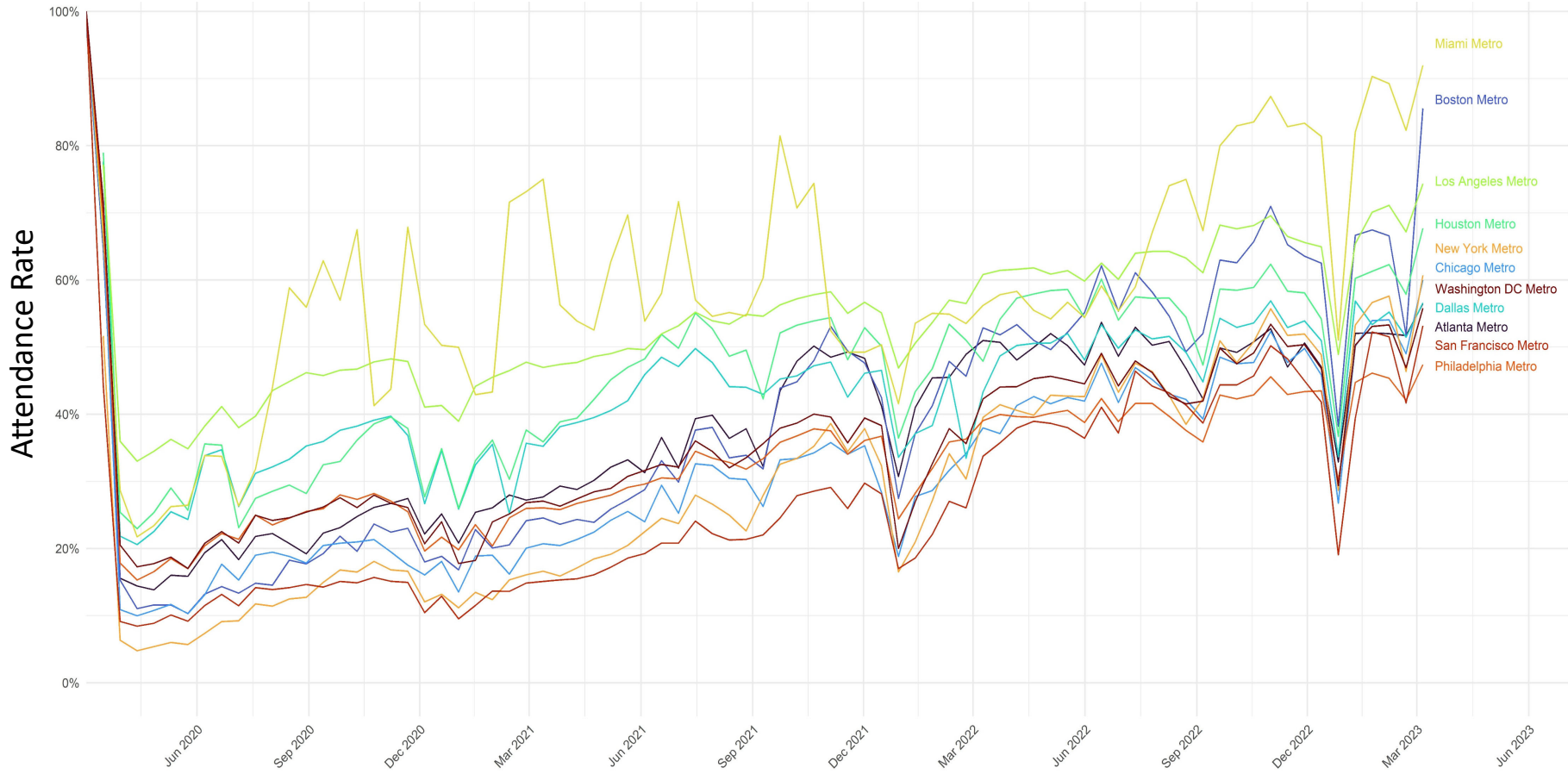


Figure 5: Kastle Building Distance to their CBD
(2157 US Buildings geo data)

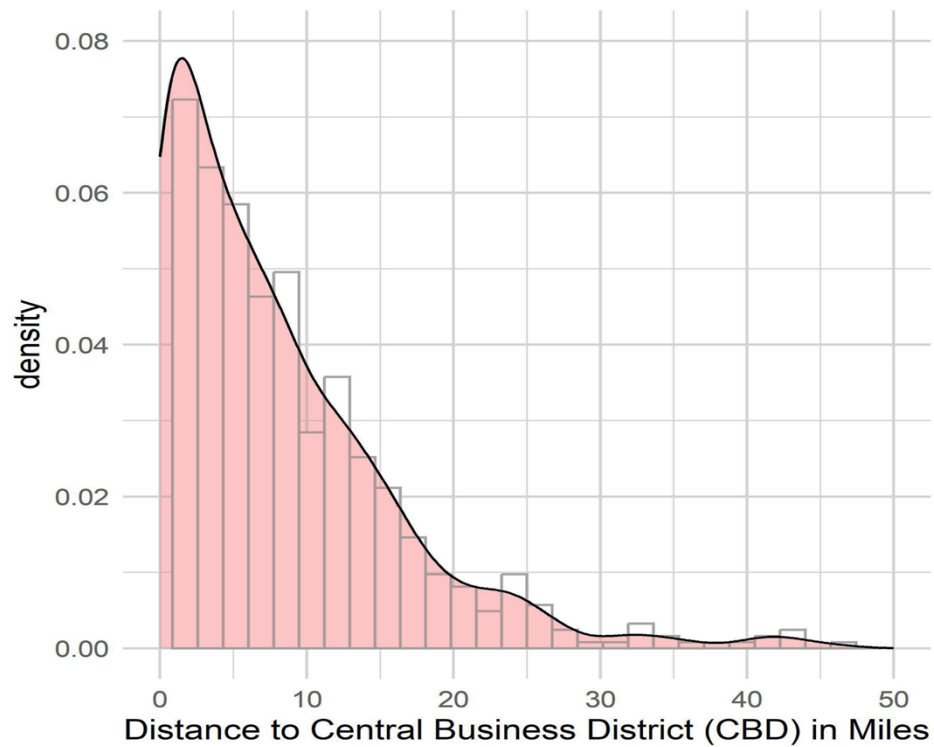


Figure 6: Average Commute Distance in Kastle Buildings (ZIP)
(2157 US Buildings, Lodes administrative data)

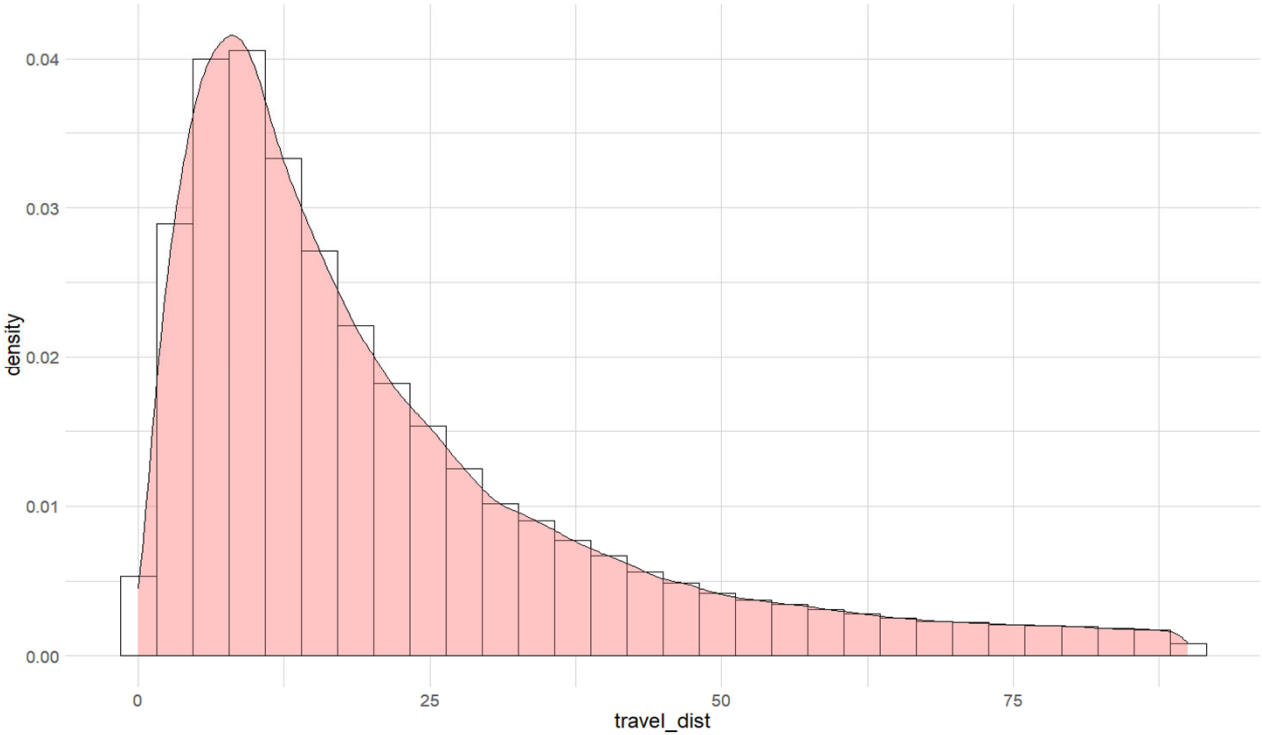


Figure 7: Building APBGR WFH Proclivity (ZIP industry mix)
(2157 Kastle Buildings)

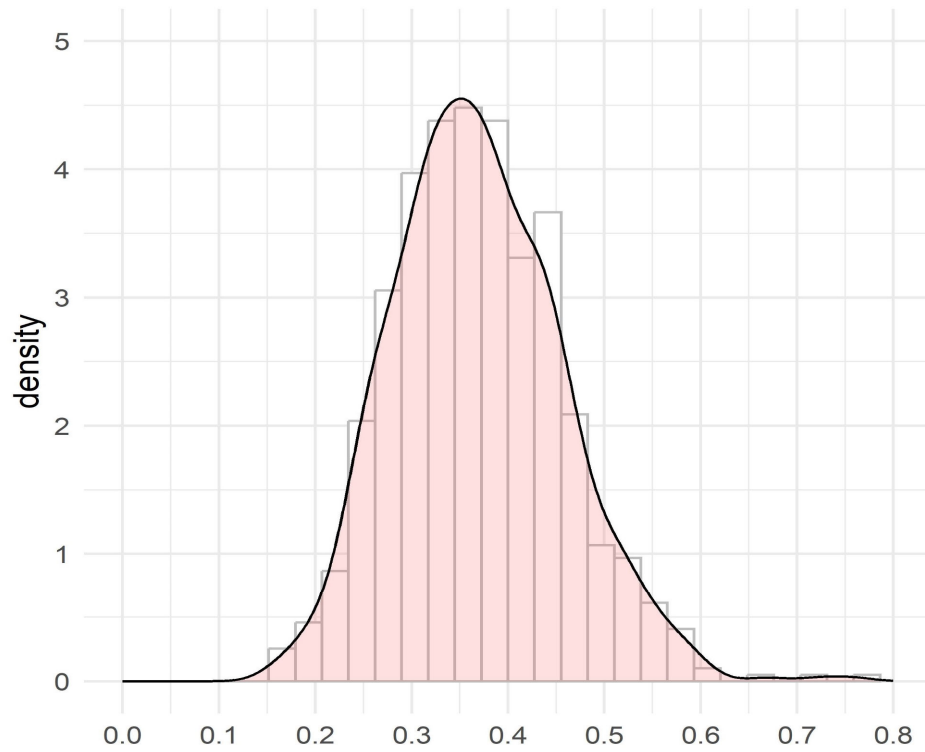


Figure 8: US Building Attendance rate, New Covid 19 Cases

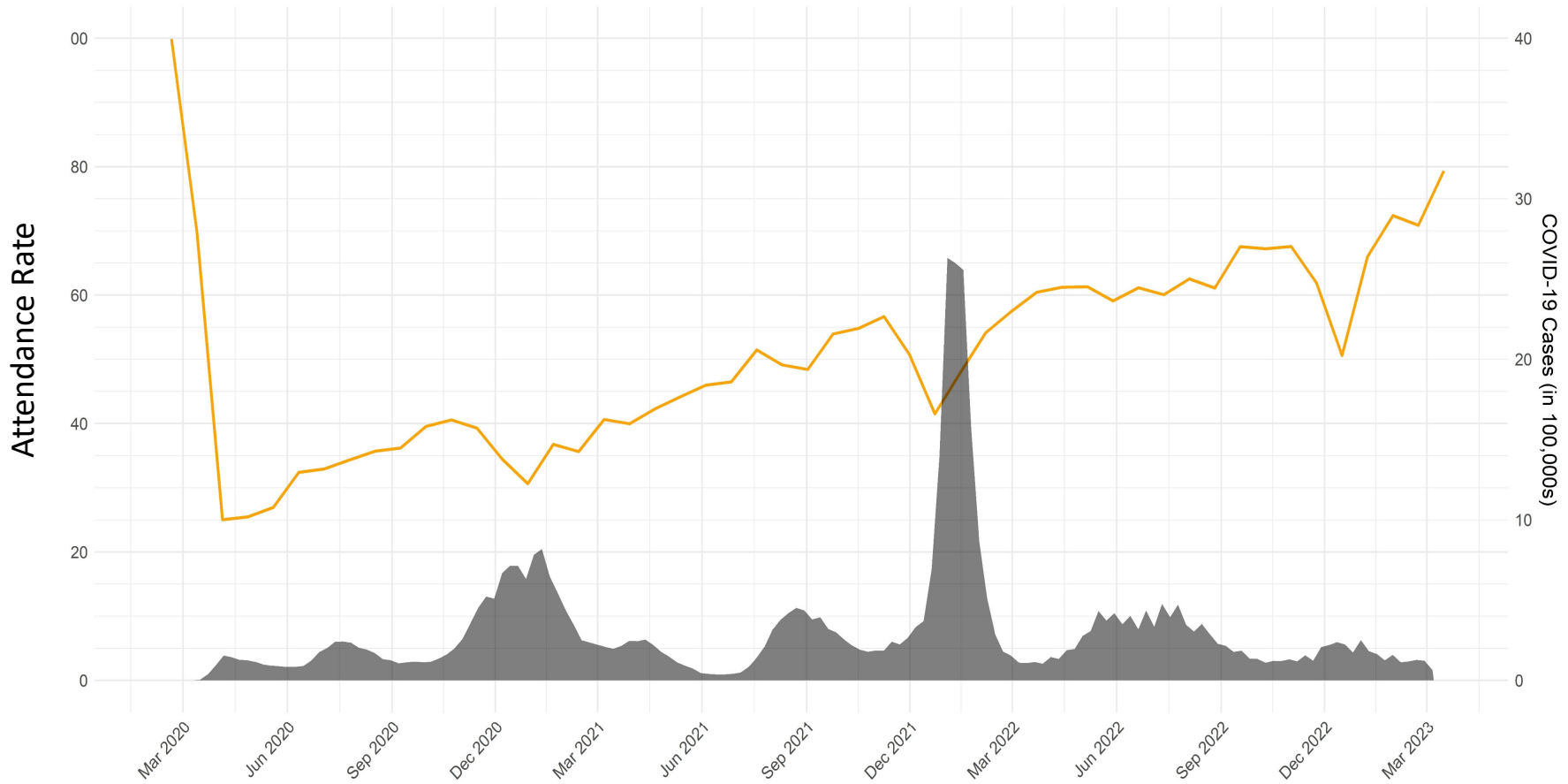


Table 1: Model of building *Attendance* over time, across buildings.
 Dependent Variable: Log Attendance Rate, 172 weeks, 114 CBSA Fixed effects)

	<i>Dependent variable:</i>					
	Occupancy Rate Log					
	(1)	(2)	(3)	(4)	(5)	(6)
ABGR WFH proclivity log	-0.685*** (0.008)	-0.613*** (0.009)	-0.557*** (0.009)	-0.556*** (0.009)	-0.556*** (0.009)	-0.556*** (0.009)
Commute Distance			-0.004*** (0.0002)	-0.005*** (0.0002)	-0.005*** (0.0002)	-0.005*** (0.0002)
Distance to CBD				0.008*** (0.0002)	0.008*** (0.0002)	0.008*** (0.0002)
Covid Rate (in 1000) Log					0.016*** (0.002)	0.016*** (0.002)
Covid Rate (in 1000): t-1 minus t-2 Log						0.002 (0.003)
Weekly Fixed Effects	X	X	X	X	X	X
CBSA Fixed Effects	X	X	X	X	X	X
Observations	310,482	310,321	310,321	310,321	310,321	310,321
R ²	0.215	0.231	0.233	0.235	0.235	0.235

Note: * p<0.1; ** p<0.05; *** p<0.01

Conclusions, Extensions

- **Economic Impacts:**

- A building 15 miles further from its CBD has a time path of attendance that is shifted 12% (points) higher.

- When the building has an estimated worker commute that is 15 miles longer, worker attendance shifts 7.5% (points) lower.

- A 15 percentage (point) greater likelihood of WFH based on industry mix shifts attendance 9 percentage (points) lower.

- **Future Extensions:**

- Non-Proportional shift impacts: test splitting of sample.

- Examine Hybrid work using daily variance over weekly average attendance.

Additional WFH Issues for office markets

- **Tenants:**

- Coordination issue in choice of on-site work days and best location for employees. *Type* of space tenants need.

- Why don't firms offer variable wages, depending on WFH?

- **Building Management:**

- Can the *same space* ever be shared between tenants?

- **Urban Spatial Structure Dilemmas:**

- Mixing land uses, puts workers closer to work. This raises attendance rates and *increases internal productivity*: Offices to residential downtown, Residential around Malls in suburbs.

- But mixing uses requires spreading out jobs and firms (around an MSA) and this *reduces external productivity*.

- Which is more important? For which firms/industries?

The end