Phoenix Center Policy Paper Number 58:

Digital Discrimination: Fiber Availability and Speeds by Race and Income

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Statutory Provision

Section 60506(a) of the Infrastructure Act states that it shall be the policy of the United States, insofar as "technically and economically feasible," that subscribers "within the service area of a provider" should benefit from the "equal opportunity to subscribe to an offered service that provides comparable speeds, capacities, latency, and other quality of service metrics" at "comparable terms and conditions."

Protected Classes

Income Level

Race, Ethnicity, Color, National Origin

Religion

Subject to …

Economic Feasibility …

"If underlying cost or geographic hurdles exist in conjunction with demand in an area that makes it unprofitable, how should the Commission address such a situation?"

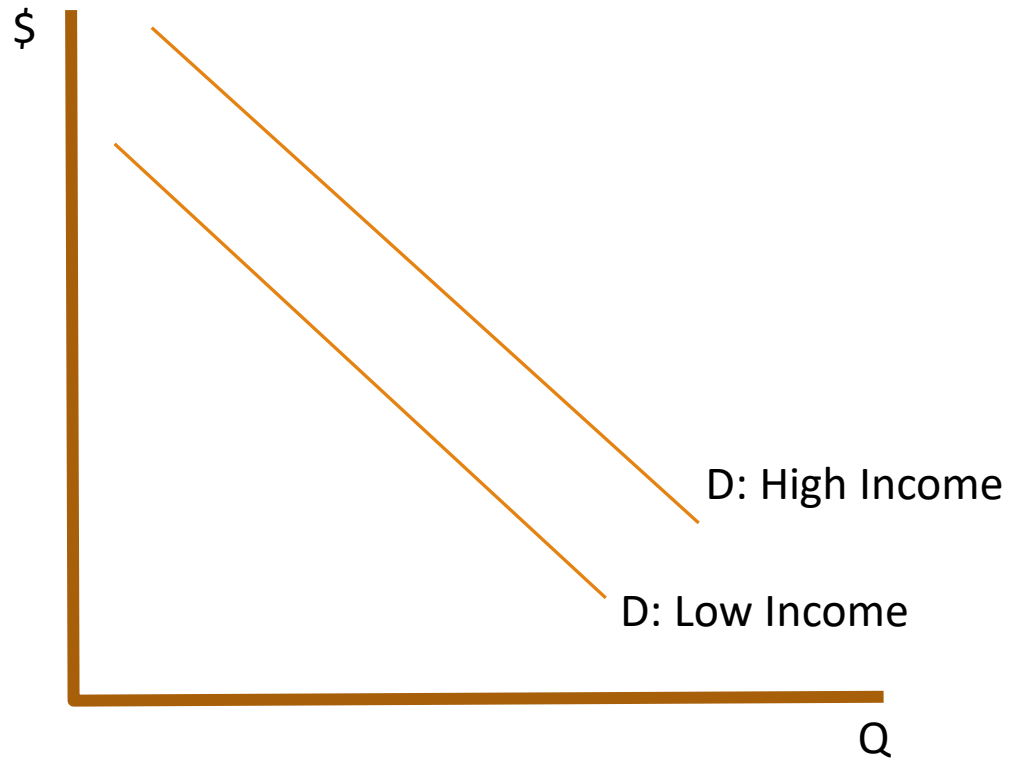
Economic Model

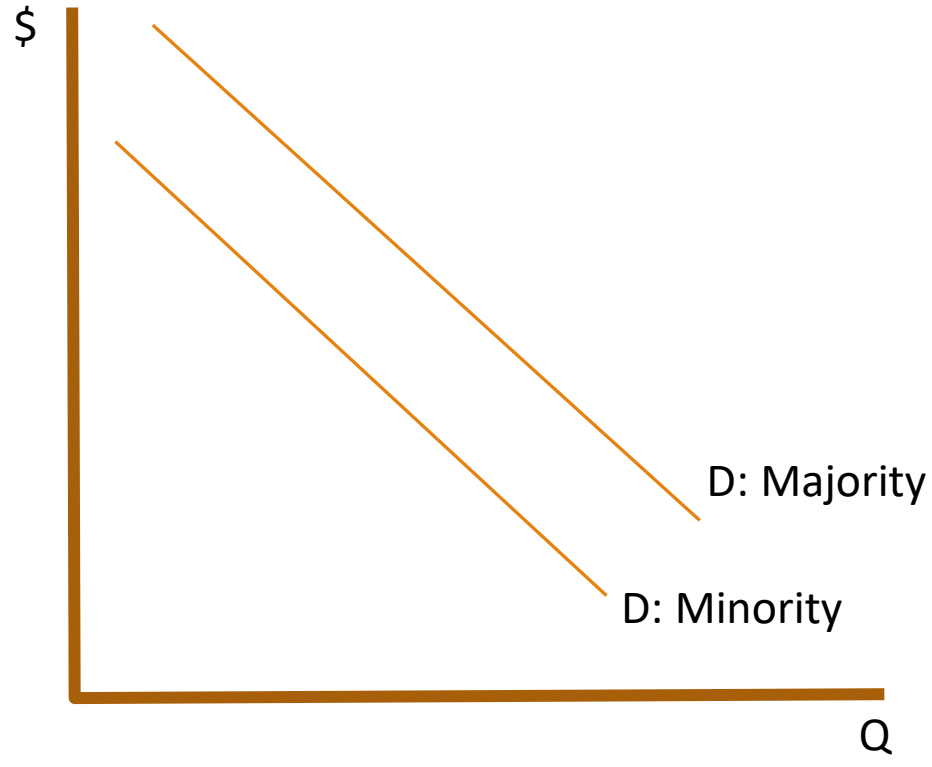
$$Y\left(\pi\left(D(X_i, r_i), C_i\right), r_i^* = 1\right) < Y\left(\pi\left(D(X_i, r_i), C_i\right), r_i^* = 0\right)$$

If profit between groups are equal (same demand and costs), is there a difference in outcomes?

Discrimination is costly (forgone profits from animus).

Adoption, Income, and Race





Simple Scenarios

Scenario 1	Rev	Cost	Discrim	Profit
Majority	40	30	0	10
Minority	40	30	0	10

Scenario 2	Rev	Cost	Discrim	Profit
Majority	40	30	0	10
Minority	25	30	0	-5

Scenario 3	Rev	Cost	Discrim	Profit
Majority	40	30	0	10
Minority	25	20	0	5

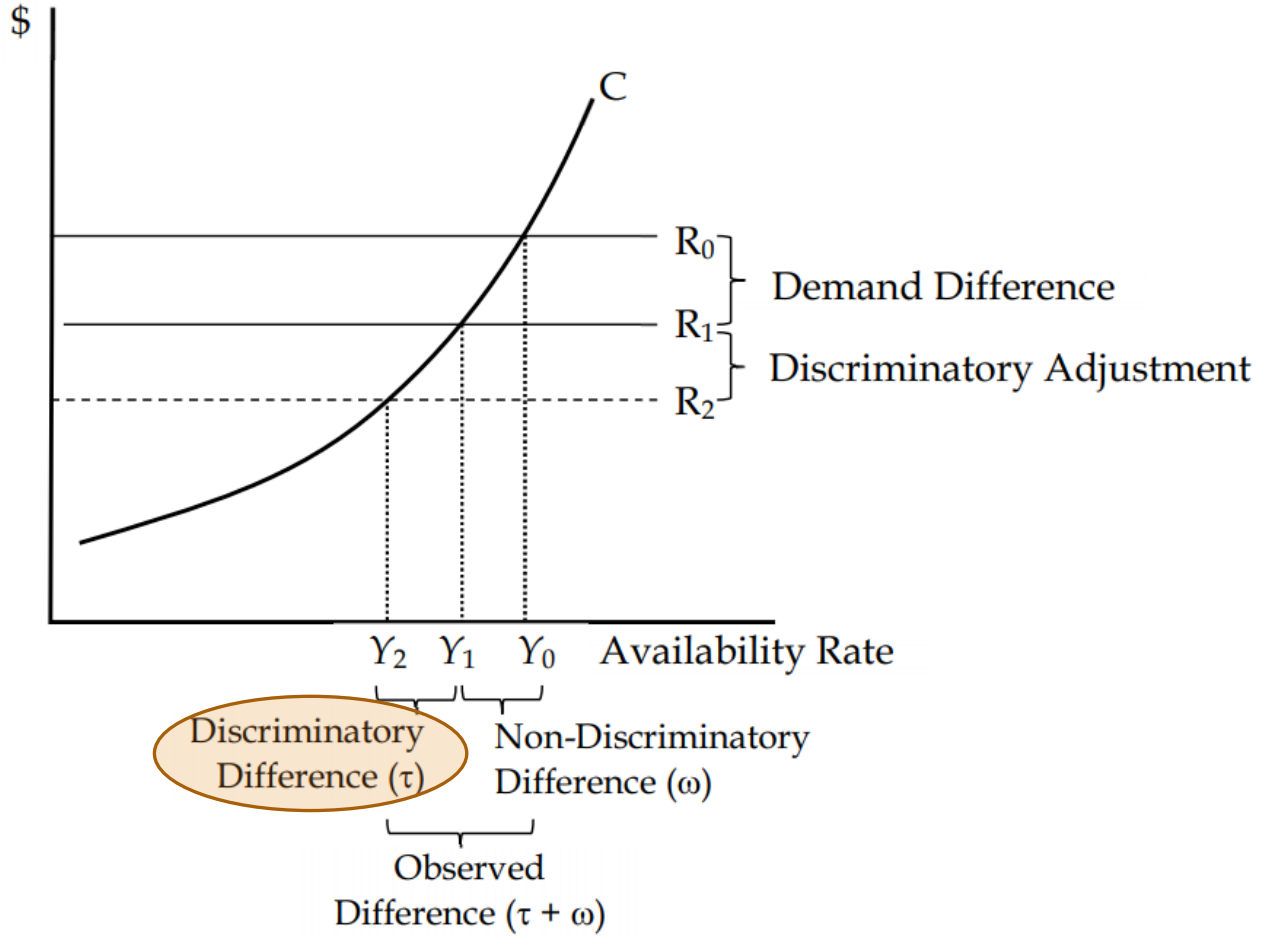
Simple Scenarios

Scenario 4	Rev	Cost	Discrim	Adj. Profit
Majority	40	30	0	10
Minority	40	30	-15	-5

Scenario 5	Rev	Cost	Discrim	Adj. Profit
Majority	40	30	0	10
Minority	25	30	-15	-20

Scenario 6	Rev	Cost	Discrim	Adj. Profit
Majority	40	30	0	10
Minority	25	20	-15	-10

Discrimination, or Not?



Economic Model

$$Y\left(\pi\left(D(X_i, r_i), C_i\right), r_i^* = 1\right) < Y\left(\pi\left(D(X_i, r_i), C_i\right), r_i^* = 0\right)$$

Need to compare outcomes between areas of equal demand and cost but different racial mixes or different income levels. But how?

We use *Coarsened Exact Matching* on demand and cost to create comparable groups across protected classes.

Definition

Digital discrimination occurs when differences in the deployment of and/or the quality, terms, and conditions of access to broadband services are not explained by differences in the profitability of serving the different areas, but instead reflect non-economic decisions to underserve protected classes in a manner that causes adverse or negative consequences.[28]

Data

Fiber Deployment & Speeds – Form 477

Demographics/Demand – ACS (5 yr, 2016-2020)

Analysis at the Block Group Level

An Interesting Problem

Table 1. Means by Share of Minority Population

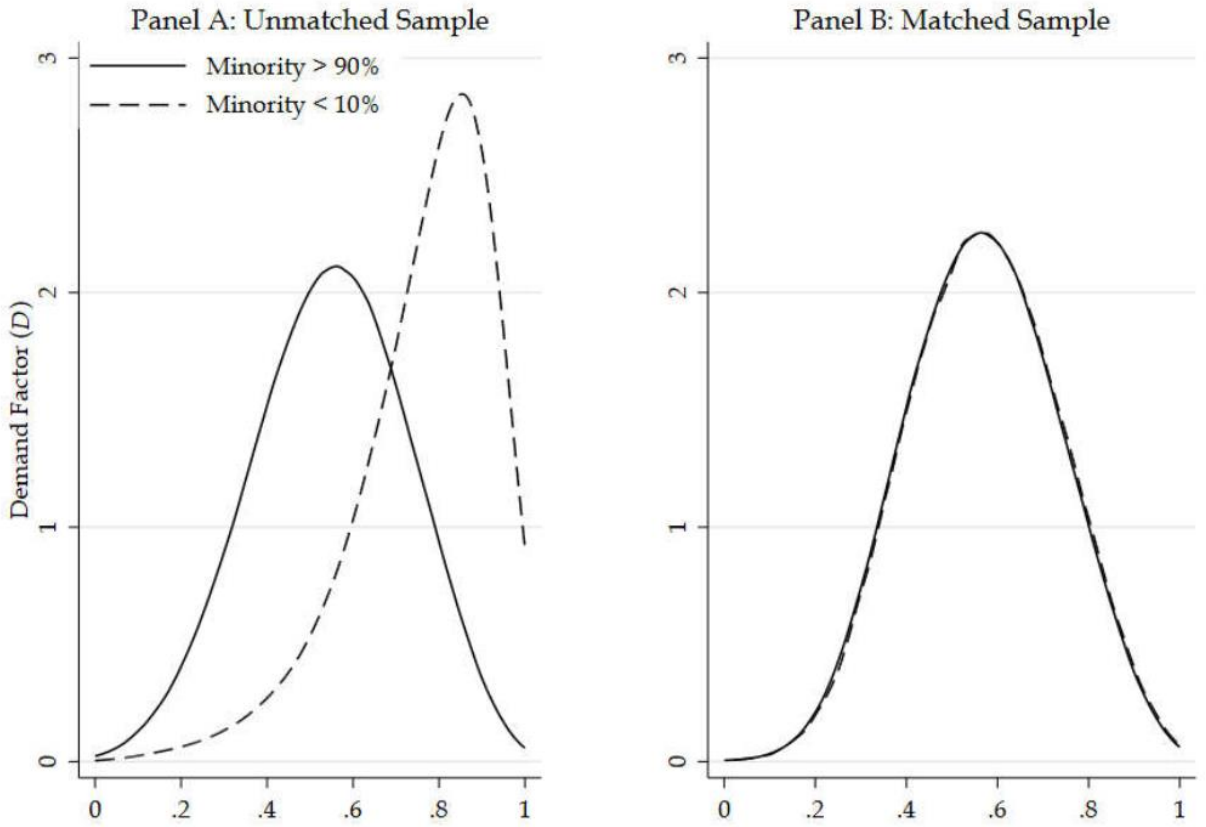
Minority Population	Fiber	Density '000	Income '000	Fixed BB Adoption Rate	Mobile BB Only
0 to 10%	0.406	1.68	93.10	0.756	0.089
10 to 20%	0.474	2.80	88.01	0.773	0.088
20 to 30%	0.473	2.95	78.98	0.754	0.098
30 to 40%	0.472	3.02	71.59	0.731	0.107
40 to 50%	0.476	3.08	65.99	0.707	0.118
50 to 60%	0.490	3.36	61.17	0.685	0.127
60 to 70%	0.482	3.80	57.69	0.659	0.135
70 to 80%	0.519	4.34	54.01	0.632	0.143
80 to 90%	0.518	4.86	49.83	0.594	0.157
90 to 100%	0.517	6.04	44.75	0.546	0.170

Cost and Demand – Factor Analysis

Table 2. Factor Analysis

Demand, D_i	Loading	Cost, C_i	Loading
Fixed Adoption	0.845	Cost Group 1	-0.784
Mobile Adoption	0.864	Cost Group 3	0.747
Tertiary Education	0.745	Cost Group 5	0.211
Computer in Home	0.707	ln(Density)	-0.791
		Rural Blocks	0.856
KMO Statistic	0.820	KMO Statistic	0.804

Coarsened Exact Matching (CEM)



Results – Racial Discrimination

Table 3. Fiber Deployment Results for Race
(Unmatched and Matched Samples)

Minority Share ($r = 0$)	Minority Share ($r = 1$)	Y_1, Y_0	$\tau + \omega$ τ	Obs	Matched Share	Stan. Diff. (D_i, C_i, F_i)
0-10%	50%-60%	0.495, 0.414	0.081***	46,971		0.49,0.78,0.22
		0.512, 0.504	0.007	34,443	0.733	0.01, 0.03, 0.01
	60%-70%	0.486, 0.414	0.072***	46,319		0.65,0.86,0.24
		0.500, 0.505	-0.005	30,803	0.665	0.01, 0.04, 0.01
	70%-80%	0.522, 0.414	0.108***	46,361		0.82,0.91,0.31
		0.542, 0.523	0.019	29,000	0.626	0.01, 0.05, 0.02
	80%-90%	0.519, 0.414	0.105***	46,755		1.04,0.97,0.36
		0.535, 0.536	-0.000	27,359	0.585	0.00, 0.07, 0.02
	90%-100%	0.518, 0.414	0.104**	48,950		1.32,1.06,0.35
		0.528, 0.541	-0.014	26,358	0.538	0.02, 0.13, 0.02

Results – Income Discrimination

Table 4. Fiber Deployment Results for Income (Unmatched and Matched Samples)

Income Level ($r = 1$)	Income Level ($r = 0$)	Y_1, Y_0	$\tau + \omega$ τ	Obs	Matched Share	Stan. Diff. (D_i, C_i, F_i)
\$0-25k	\$50-75k	0.396, 0.437	-0.041	42,005		1.65,0.56,0.00
		0.401, 0.438	-0.036	28,727	0.684	0.02, 0.02, 0.01
	\$75-100k	0.396, 0.470	-0.074**	29,568		2.20,0.66,0.12
		0.468, 0.475	-0.006	15,820	0.535	0.03, 0.03, 0.00
	\$100-150k	0.396, 0.533	-0.138***	25,846		2.81,0.69,0.31
		0.546, 0.549	-0.003	8,721	0.337	0.21, 0.04, 0.00
	\$150-250k	0.396, 0.620	-0.224***	13,662		3.37,0.80,0.57
		0.664, 0.637	0.026	1,666	0.122	0.17, 0.15, 0.01

Results – Racial Discrimination

Table 5. Download Speed Results for Race (Unmatched and Matched Samples)

Minority Share ($r = 0$)	Minority Share ($r = 1$)	Y_1, Y_0	$\tau + \omega$ τ	Obs	Matched Share	Stan. Diff. (D_i, C_i, F_i)
0-10%	50%-60%	1086, 1022	64.1***	46,971		0.49,0.78,0.22
		1044, 1060	-15.8	34,443	0.733	0.01, 0.03, 0.01
	60%-70%	1084, 1022	62.7***	46,319		0.65,0.86,0.24
		1029, 1054	-25.0	30,803	0.665	0.01, 0.04, 0.01
	70%-80%	1091, 1020	71.0***	46,361		0.82,0.91,0.31
		1029, 1052	-23.4	29,000	0.626	0.01, 0.05, 0.02
	80%-90%	1090, 1018	71.9***	46,755		1.04,0.97,0.36
		1024, 1043	-19.7	27,359	0.585	0.00, 0.07, 0.02
	90%-100%	1094, 1013	81.4***	48,950		1.32,1.06,0.35
		1020, 1026	-6.30	26,358	0.538	0.02, 0.13, 0.02

Results – Income Discrimination

Table 6. Download Speed Results for Income (Unmatched and Matched Samples)

Income Level ($r = 1$)	Income Level ($r = 0$)	Y_1, Y_0	$\tau + \omega$ / τ	Obs	Matched Share	Stan. Diff. (D_i, C_i, F_i)
\$0-25k	\$50-75k	1020, 1063	-42.9***	42,005		1.65,0.56,0.00
		1001, 1001	0.10	28,727	0.684	0.02, 0.02, 0.01
	\$75-100k	1022, 1045	-22.7*	29,568		2.20,0.66,0.12
		999, 1005	-6.30	15,820	0.535	0.03, 0.03, 0.00
	\$100-150k	1024, 1010	14.2	25,846		2.81,0.69,0.31
		1034, 1012	22.2	8,721	0.337	0.21, 0.04, 0.00
	\$150-250k	1039, 997	42.0	13,662		3.37,0.80,0.57
		1054, 1024	30.2	1,666	0.122	0.17, 0.15, 0.01

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