

FEDERAL SUBSIDIES AND BROADBAND COMPETITION

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Motivating issue

- What impact federal subsidies to broadband?
- Largest federal program—e-Rate to schools and libraries
 - \$2.25 B/yr, administered through USF
 - (but only 75% disbursed historically)
 - Since late 1990s
 - Sliding scale subsidy rate, higher for poor and rural— important fact
 - Helped buy connections to Internet for grantees
- Contrast with smallest federal program?
 - Rural health care, < \$30M/yr, also USF
- Did these programs support broader objectives of increasing broadband access? Help defray fixed costs of infrastructure in nearby areas? Facilitate exploitation of economies of scale and scope in building out broadband networks? Increase demand via diffusion/network effects?

E-rate as Stimulus to Community Broadband Access

“In addition to the discounted services that are made available to eligible libraries and schools, E-rate has served as a catalyst for other broadband development in the communities where these anchor libraries and schools exist. **By taking broadband to eligible schools and libraries under the E-rate program, service providers are, in many cases, able to make the business case necessary to provide advanced services to residential customers and others in those same and surrounding communities.”**

American Libraries Association Filing before the FCC, GN Docket No. 09-51, 2009, p. 4.

E-rate as Stimulus to Community Broadband Access

To drive demand, the government itself has to have appropriate levels of broadband connectivity, and those would require institutional levels far beyond those available in the mass market. **Connecting public anchor institutions such as schools, libraries, health care facilities and government buildings to such higher levels of connectivity would help drive demand and would lay the physical and economic groundwork for further upgrades in the mass market.** To a significant extent the government has started doing this with the E-rate and Rural Health programs that were established in the 1996 Telecommunications Reform Act.

Blair Levin (Former Executive Director of the Omnibus Broadband Initiative, FCC), **Universal Broadband: Targeting Investments to Deliver Broadband Services to All Americans**, (Aspen Institute), 2010, p. 28.

E-Rate as Stimulus to Community Broadband Access

“In addition to supporting ongoing broadband-grade service to schools, there is evidence that **the E-Rate program has catalyzed access to the Internet in surrounding communities** and other institutions.”

EdLiNC Filing before FCC, GN Docket Nos. 09-47, 09-51, 09-137, Nov. 2009, p. 2.

“Moreover, E-Rate support has served as a catalyst to bring broadband services to entire communities. **Thanks to the E-Rate program, the small town of Edinburg, Mississippi, which consists of just two convenience stores, a pawn shop, a bank, and a single school, now has access to broadband fiber.** Broadband service was made available in Edinburg when local service providers were forced to lay fiber between the county seat and Edinburg’s school to establish an E-Rate supported Internet connection. Because the fiber was government-owned and part of the area’s public infrastructure, local Edinburg businesses were able to tap into that new line and can now have fiber access.”

CoSN-ISTE Filing before FCC, WC Docket No. 05-337, 2011, p. 1.

Context

- Period studied 2005-2008 was one of dramatic changes in broadband connectivity
 - June 2005: 40% of US zip codes < 4 providers
 - 25% of US population
 - June 2008: 5.5% US zip codes < 4 providers
 - 5% of US population
- e-Rate program largest subsidy to broadband connectivity over this period
 - had a lot of administrative problems, not discussed here

Data

- Large panel data set assembled from multiple sources
- ~30,000 zip codes, 4 years
- Time varying zip code level data on
 - # broadband providers from FCC
 - But 1-3 providers censored in public data!
 - Tax return-based data from IRS
 - e-Rate, RHC funding commitment data from USF
- Time invariant data, very rich data set
 - Census year economic/demographic characteristics of zips
 - Terrain characteristics of zips
- (Variables in time invariant data sets turned out to be not so useful for statistical reasons)

Simple model of entry into BB markets

- Monopolistic competition-type framework
- Estimating what is called a “reduced form”
- Equilibrium number of competitors as a function of demand- and cost-shifting variables

Estimation Issues

- FCC censoring of observations on # BB providers in 1-3 range creates problems
- Simply deleting censored observations creates potential bias, inconsistency in estimated coefficients, since censoring is not random
- Could impute 1-3 randomly in censored observations
 - Statistical properties unknown
- Can model imputation error
- Deletion, imputation, imputation + model imputation error pursued in paper
- (FCC reports provided enough info to “uncensor” 60+ censored obs, very helpful)

Time-Varying Variables

t2006, t2007, t2008	time indicator variables, =1 respectively if year is 2006, 2007, 2008, else 0 (omitted group is 2005)
cum_rhcl1	cumulative \$ USF funding commitments for rural health centers through previous year
cum_ertl1	cumulative \$ USF e-Rate funding commitments through end previous year
ln_numrets	log number income tax returns
agicat	categorical variable describing 14 ranges of adjusted gross income (AGI)
eitc_ret	share of returns filing for earned income tax credit (poverty proxy)
oth_ret	share of returns filing with other or unknown status (omitted group is single)
joint_ret	share of returns filing as married, joint
hdhouse_ret	share of returns filing as head of household
sch_c_ret	share of returns filing schedule C (self-employed proxy)
sch_f_ret	share of returns filing schedule F, Farm (rural proxy)
a30_ret	share of returns filing with age < 30
a3044_ret	share of returns filing with age 30-44
a4560_ret	share of returns filing with age 45-60 (omitted group > 60)
aunspec_ret	share of returns filing with age unspecified
ilib_	binary indicator variable for library in zip code
ischl_	binary indicator variable for school in zip code
ert_sch_f	interaction, sched f share & e-Rate \$
ert_eitc	interaction, eitc share & e-Rate \$

Time Invariant Variables

- Many but irrelevant— appropriate statistical test strongly rejects hypothesis that unobservables uncorrelated with observed variables
- Means that “fixed effects” (data differenced to remove unobserved time constant heterogeneity) required
- Time invariant variables disappear from estimated relationship after we difference data

Effects of e-Rate program

- When EITC share of returns, Sched F return share = 0
 - Interaction effects also zero
- \$1M e-Rate → -.02 competitors
 - Tiny effect, not statistically significant
 - Negative sign consistent with e-Rate raising costs for providers in monopolistic competition model
 - Rich, non-rural areas (EITC, Sched F = 0) have lowest subsidy rates, little offsetting stimulus to demand for services
- With EITC share of returns .75,
 - \$1M e-Rate → +.21 providers
 - Small effect but statistically significant
- With Sched F share of returns .50
 - \$1M e-rate → +1.3 providers
 - Economically and statistically significant effect
 - subsidy rates and potential demand stimulus highest in poor rural areas

Effects of RHC Program

- A tiny program, but
- \$500K subsidy → + 1 provider
- Economically and statistically significant
- Targets only rural areas

3 controls for household income and household density

- Inverted U pattern for AGI categories
- Strong effect for # returns filed
 - 10% increase in # returns filed \rightarrow .2 increase in # providers
 - # returns increases with both household income (share of households filing income tax returns) and household density (# household per spatial area of zip code)
- Increase in EITC share of returns reduces providers, by not by much, and not statistically significant

Other points

- School in zip code associated with .16 increase in # providers, statistically significant
- But not libraries!
 - School spending dwarfs lib spending?
- Time/technology effects large
 - 2006: 2005 +.6 providers
 - 2007: 2005 + 1.1 providers
 - 2008: 2005 + 2.8 providers
- 2007-2008 → average increase
 - = 1.7 providers nationally
- 2007-8 the “great leap forward”?

Fixed Effects Estimator			
Treatment of Censored Observations:			
Deletion	Random Imputation	Random Imputation w/ error model	
t2006	0.670*** (0.0188)	0.903*** (0.0156)	0.615*** (0.0153)
t2007	1.103*** (0.0371)	1.519*** (0.0326)	1.089*** (0.0329)
t2008	2.922*** (0.0259)	3.283*** (0.0215)	2.798*** (0.0232)
ilib_	-0.0995 (0.113)	-0.0624 (0.105)	-0.0918 (0.110)
ischl_	0.114+ (0.0673)	0.0709 (0.0601)	0.156* (0.0630)

Conclusion

- Methodologically:
 - Critical to allow for correlated unobservables in studies of this subject, even with very rich set of controls– question cross-sectional studies!
 - Results suggest that deleting observations may be preferable to imputing without modeling imputation error
- Substantively,
 - e-Rate had little apparent effect on broadband competition EXCEPT in the most rural areas
 - Tiny RHC program, specifically targeting rural areas, seems to have had very significant effects in those areas
 - Adds weight to general policy rationale for focusing subsidy programs on disadvantaged rural areas where costs are highest and availability lowest