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Estimating the impact of low-income universal service programs ☆

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ABSTRACT

This policy study uses U.S. Census microdata to evaluate how subsidies for universal telephone service vary in their impact across low-income racial groups, gender, age, and home ownership. Our demand specification includes both the subsidized monthly price (Lifeline program) and the subsidized initial connection price (Linkup program) for local telephone service. Our quasi-maximum likelihood estimation controls for location differences and instruments for price endogeneity. The microdata allow us to estimate the effects of demographics on both elasticities of telephone penetration and the level of telephone penetration. Based on our preferred estimates, the subsidy programs increased aggregate penetration by 6.1% for households below the poverty line. Our results suggest that automatic enrollment programs are important and that Linkup is more cost-effective than Lifeline, which calls into question a recent FCC (2012) decision to reduce Linkup subsidies in favor of Lifeline. Our study can inform the evaluation of similar universal service policies for Internet access.

1. Introduction

Universal service for telephony has at least nominally been a public policy concern for over a century (Mueller, 1997). Universal service policies for ordinary telephone service were expanded significantly in the wake of the 1996 Telecommunications Act, subsequently were expanded to encompass wireless service, and currently are under consideration for Internet service (e.g. Federal Communications Commission, 2012; Office of Congresswoman Doris Matsui, 2009). Globally, universal service in telecommunications can be important for economic growth (Roller and Waverman, 2001), and expanding service is a priority in development policy (Estache and Wren-Lewis, 2009).[1] Universal service concerns usually are directed at two different, but somewhat overlapping, groups: rural and low-income households. Our focus is to develop a model of the demand of low-income households and to understand the economic factors affecting their decisions to subscribe to telephone service. Our model uses 2000 U.S. Census microdata to evaluate the effectiveness of the Lifeline and Linkup subsidy programs at increasing the telephone penetration of households below the poverty line. Our study develops methodology and employs appropriate data for evaluating the effectiveness of low-income subsidy programs. By measuring the determinants of telephone penetration of low-income households across different demographic groups, the study provides policy makers and the Census Bureau new information pertinent to universal service and the "digital divide."[2] The new framework, and an understanding of its data requirements, is important for evaluating current telephone

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[1] See Riordan (2002) for a more complete background on the economics of universal service. Rationales for universal service policies, though controversial, range from efficiency reasons stemming from network externalities or economies of scale, to equity reasons (Laffont and Tirole, 1993), to political economy or sociological reasons concerned with political discourse or social cohesion.

[2] "Digital divide" refers to differences in the extent to which different groups of households have access to advanced telecommunications and information services.

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subsidy programs, and potentially for the gathering debate on Internet access subsidies.

Overall U.S. telephone penetration from 2000 is high — over 94% according to the Federal Communications Commission (FCC) "Penetration Report."[3] This substantial achievement of universal service masks considerable demographic variation. Penetration rates are lower for low-income households — 87.5% of households with income less than $10,000 had a working telephone in their households. Telephone penetration rates varied from 80.0% for households with an annual income below $5000 to 98.4% for households above $75,000, and from 95.2% for white households to 89.3% for black households. The demographic variation was even greater for low-income households. For example, 83.1% of white households with an annual income below $5000 had telephone service, while 73.0% of low-income black households had telephone service. A major goal of our analysis is to better understand the reasons for this demographic variation.

In the United States there are two major low-income support programs for telephone service. The Lifeline program provides a subsidy that reduces monthly charges for eligible low-income subscribers. The Linkup program reduces the initial connection fee that low-income households pay to establish telephone service. In the wake of the 1996 Telecommunications Act, the FCC dramatically increased the size of its basic Lifeline subsidy and provided additional matching support for state-funded Lifeline programs.[4] The states responded to the federal matching support opportunity in various ways. The FCC's implementation of the 1996 Act did not change the federal Linkup subsidy. Fig. 1 summarizes the evolution of total federal low-come support. It shows a sharp jump in support in 1998 that more or less stabilizes around the time of the 2000 Census. After that, the growth in payments accelerates following the FCC's decision to allow prepaid wireless carriers to begin receiving low-income support in 2005. The substantial jump beginning in 2009 reflects sharply increased payments for prepaid mobile service. Fig. 2 illustrates the heterogeneity of Decennial Census penetration rates and low-income support payments across the states. The upper panels show the state-level increases between 1990 and 2000 in penetration rates for households below the poverty line. The bottom panels show the corresponding increases in federal low-income support payments (in 2000 dollars) divided by the number of poor households in the state, suggesting a relationship between the FCC's low-income programs and the penetration rates of poor households. Nationally, the penetration rate among poor households rose from 81.5% in 1990 to 91.5% in 2000.

The market for telephone services has experienced dramatic changes since 2000. The growth in wireless services has resulted in wireless becoming the primary form of connection subsidized by the Lifeline program. In the year of our microdata, 2000, wireless service had not yet begun replacing landline service as a household's primary connection. Blumberg and Luke (2013) report that only about 2% of all households were wireless-only households in 2003, and wireless carriers received less than 1% of the FCC's low-income telephone subsidies in 2000 (FCC, 2013). While we cannot determine to what extent our estimates are externally valid to assess low-income programs for wireless services or broadband, our analysis provides new evidence on the effects of the FCC's low-income programs in 2000, near the peak of landline penetration and landline subsidies for universal service. Our findings of significant price-sensitivity heterogeneity and high measured discount rates can inform the analysis of other programs that address the digital divide, as well as other low-income programs. As for the current state of universal telephone service, the penetration rate (including wireless) for households earning less than $10,000 per year has risen to 92.6% in 2013, but this percentage still falls well short of the 96.1% penetration rate for all households (FCC, 2013).

Our study differs from prior evaluations of universal service subsidies by taking advantage of confidential microdata from the Long-Form Questionnaire of the 2000 Decennial Census. With demographic details from a cross-section of over a million households, we can estimate how demographics affect both elasticities of telephone adoption and levels of telephone penetration, while public data only allow for crude estimates from aggregates at the Census Tract level. We consider penetration specifically for poor households (rather than overall penetration), so implicitly we allow price sensitivity for poor populations to differ from the rest of the population. The distinction between the elasticity effects and level effects of demographics is empirically important. We show that home ownership and age do little to explain the differences in the level of penetration between races, but they explain much of the gap in elasticities of adoption between races. We find that young renters are the group that can be most easily influenced through universal service subsidies.

Our work further differs in at least three important ways from existing published studies that evaluate the aggregate impact of Lifeline and Linkup. First, using various data sources, we have constructed a dataset that is more extensive than other datasets used to study low-income telephone penetration. We use prices at a disaggregated level, rather than the state level, and we directly exploit price variation resulting from new Lifeline subsidies introduced in wake of the 1996 Telecommunications Act. We also are the first to use specific Linkup prices, rather than a Linkup dummy.[5] Studies that rely on statewide data use statewide-average residential prices, which mask substantial information because residential service prices can vary substantially within states.[6] For example, in California in 2000, monthly rates for 100 calls a month for Lifeline customers varied from $5.01 to $6.90 and for non-Lifeline customers varied from $11.62 to $15.51. Data on prices and service characteristics obtained from Bell Operating Company (BOC) tariffs and Census microdata on telephone penetration and demographics are matched to more than 6000 wire centers—geographic areas each including all customers connected to a particular local switch. The sample includes wire centers from 39 states and the District of Columbia.

Second, our preferred specification controls for the possible endogeneity of Lifeline prices. Lifeline price endogeneity is a concern because states responded to post-1996 changes in federal Lifeline policy differently.[7] Ignoring this endogeneity potentially biases downward the estimated elasticity of demand with respect to Lifeline prices. In addition, we also use the size of the local calling area as an explanatory variable (following Perl, 1984; Taylor and Kridel, 1990). The inclusion of this value-of-service variable in the demand specification by itself may alleviate price endogeneity because states typically set higher prices in places with larger local calling areas.

Third, our specifications control for automatic enrollment policies. In some states, there are low-income programs that automatically establish eligibility for Lifeline and Linkup. Households participating in those programs can ask the office administering the program to automatically initiate enrollment. In other states, the burden is on the household to establish eligibility. We interpret automatic enrollment policies as reducing the transaction cost of securing subsidized service.

[3] The FCC reports penetration across the most disaggregated race-income groups. The FCC penetration data is based on the Current Population Survey (CPS) question, "Is there a telephone in this house/apartment?" (Belinfante, 2001). All FCC income cutoffs are in March 1984 dollars.

[4] For specifics of the Lifeline and Linkup programs, see the unpublished working paper, Ackerberg et al. (2009).

[5] Crandall and Waverman (2000) use a dummy variable for Linkup and obtain an unexpected negative effect on penetration. They suggest that the result is a consequence of limited variation: only two states lacked a Linkup program in 1990. They also suggest that their Linkup result may be due to reverse-causation: states with high penetration rates choosing not to participate in federal low-income programs.

[6] For example, Garbacz and Thompson (2002, 2003) use state-level data from the four decades of the Decennial Census and Erikson et al. (1998) use state-level data from the Current Population Survey. There is within-state variation in the subsidized monthly prices in 24 of our sample's 39 states.

[7] Crandall and Waverman (2000) acknowledge the endogeneity issue. They attempted to estimate equations with Lifeline and Linkup as endogenous variables but were unsuccessful.