Globalism and Localism in Telecommunications
E.M. Noam and A.J. Wolfson (Editors)

Universal Service: Creating Effective Policies for the Future

Universal Service: Realities and Reforms

Michael A. Einhorn

1. Introduction

Market competition for telecommunications services and equipment has put increasing pressure on strategies implemented to promote universal service. Two problems have resulted. First, customers have substituted from subsidy-bearing overpriced services to less efficient alternative technologies free of subsidy contributions. Second, certain strategies have awarded dollars to recipient companies or end-users in a manner that may have discouraged efficient cost management and/or customer choice. Policy-makers must now consider reforms that would eliminate these distortions.[1] This paper considers some options.

2. Universal Service

There are two justifications for enforcing a universal service obligation. First, immediate access to a telephone is sometimes necessary to preserve personal property or human life; universal service programs can be defended through a concern for safety and social welfare.[2] Second, each joining customer confers network externalities upon other subscribers; i.e., incumbent subscribers may receive calls from or place calls to a newcomer. A universal obligation to provide a particular service may mean granting immediate access for all potential customers, enabling general affordability, or simply promoting a basic understanding of the available service offering.[3] Regulators must decide what services should be protected, who should receive subsidies, how should subsidy dollars be paid and generated, how much money is required, and how the program should be administered. General affordability can be ensured or encouraged through specific rate ceilings, geographically averaged prices, and/or targeted subsidies for qualified customers and exchanges.[4]

Brockway and Colton[5] delineate four issues for determining which services should be provided "universally" through some kind of regulator mandate. First, how widespread is the use of the technology or service?[6] Second, what is the incremental cost of providing such technology or service to any unserved household? Third, how important is the technology or service to the ability of the household to be integrated into the nation's social, cultural, and economic fabric? Finally, to what extent is the ability to use the service dependent on its provision by the regulated utility, as opposed to open market competition?

Based on a review of several suggested universal service plans in the United States, a rough concensus of what regulators may reasonably attempt to secure for all American households is as follows:[7]

1. Basic voice grade service to the local switch with touchtone capability
2. Operator services, 911, directory assistance, and directory listing
3. Repair services
4. Equal access to interexchange carriers
5. Telecommunications relay (if needed)

Reasonable opinions may differ regarding the need for digital switching, unlimited local calling, and the availability of call forwarding, call waiting, three-way calling, and caller ID. Generally omitted from present lists of universal service obligations (but arguably admissable in the future) are narrowband ISDN, video, wireless, Internet services, gateway access, and home shopping.[8]

Whatever the ideal notion of universal service is, the current subsidy scheme is inefficient and distorts the outcome of a competitive market. There are four general imbalances in present tariff structures that regulators have enacted in order to make basic phone rates more affordable: monthly line charges for single-line customers are below average embedded cost, local price-cost markups are less than long-distance analogs, usage prices are geographically averaged without regard to transport distance or traffic density, and peak and offpeak prices do not correspond to actual load patterns. Specific programs to subsidize high-cost exchange or low-income customers draw revenues from IXCs and their customers based on relative minutes-of-use or presubscribed lines. Present procedures for subsidizing access do not allow customers to choose among competing providers of local service and long-distance access. Alternative strategies involving direct tax payouts, comprehensive levies on competitive services, or auctions might be more equitable and/or efficient.

Economic analysis is a particularly useful means for determining how to raise and dispense subsidy dollars, especially in competitive markets. We now describe present U.S. mechanisms and alternatives that may improve economic efficiency.

3. Present Strategies in the U.S.

An elaborate set of rules has been established at the federal and state levels in the U.S. to subsidize residential and single-line business.[9] We now review these strategies.[10]

General Procedures

Regulators have instituted subsidy schemes that keep single-line prices below average embedded cost. Under Part 36 of the FCC's Separations and Settlements Procedures, 25% (i.e., $6) of local company "loopside" (i.e., nontraffic sensitive) costs are assigned for revenue recovery to the interstate jurisdiction of the FCC. Under Part 69, the maximum allowable subscriber line charge for recovery of these interstate costs is now fixed at $3.50 per month for single-line customers. The resulting deficit is recovered from per minute carrier common line charges, which exceed the actual marginal cost of providing switched interconnection.[11]

Recovery of the CCLC is the responsibility of the National Exchange Carrier Association.[12] Based on traditional accounting costs, total subsidies for NTS costs from common line charges now exceed $2.9 billion.[13] Because state regulators similarly limit monthly subscriber line charges for intrastate costs, these costs are also partially recovered from access charges and intraLATA toll revenues.

Second, regulated trunk call rates in interstate and intrastate jurisdictions are generally based on average cost levels regardless of relative traffic amounts. With per call transport costs that are generally below wide-area averages, calls that originate in high-volume local exchanges are overpriced. This may attract inefficient entrants who can exploit the price-cost differential.

Underpricing of telephone services now exists in low-volume exchanges. This evidently works to the advantage of rural customers who generally interconnect in these exchanges. Across a survey of 424 small rural companies, OPASTCO[14] calculated that the intrastate and interstate toll deaveraging would increase average customer monthly bills by $10.99 and $7.44; customers in these companies would pay $1.1 billion more if all subsidies were eliminated. Depreciation rates for local equipment have been based upon inflated estimates of plant lifetime to minimize the revenue charge per customer and to encourage subscription. Due to advances in carrier and switch technology, depreciation lifetimes are unrealistically long.

Federal Programs

The FCC also instituted several programs to provide financial assistance to high-cost exchanges and low-income customers. The commission established the Universal Service Fund in 1986 to assist high-cost local companies recover their intrastate revenue requirement. Depending upon size and the degree of cost excess, a local company with per line NTS costs above 115% percent of the national average can receive revenue assistance for up to 75% of its excess.[15] Subsidized companies tend to serve geographic areas with smaller and more dispersed populations with fewer high-revenue business customers; average loop length is longer, scale economies are less frequently realized, and technological upgrade is more expensive on a per line basis.[16]

Twenty-eight IXCs, each having more than .05% of the nation's presubscribed lines, now make contributions to the Fund via a fixed monthly charge (approximately $6/year) per presubscribed line.[17] In 1993, the Universal Service Fund recovered $741 million on behalf of 36.8 million loops (of a national total of 139.4 million); 85% of USF revenue payout went to small companies with less than 200,000 loops. The effect upon local prices can be substantial; without support, rates in New Mexico would increase by $35.67 with the highest monthly charge at $122.32.[18] Under the Dial Equipment Minutes Weighting Program, companies with fewer than 50,000 loops also receive $260 million of additional subsidy assistance for recovery of intrastate switching costs that are reallocated to the interstate jurisdiction. Companies with fewer than 10,000 access lines may increase their interstate allocation of switching costs by a factor of 3. Companies with 10,000-20,000 access lines may increase their allocation by a factor of 2.5; the weighting factor for 20,000-50,000 access lines is 2. The maximum allowable reweighting is 85%. NECA[19] calculated that $1.1 billion of switching costs are shifted to the interstate jurisdiction. This would amount to $3.92 per access line.[20]

Link-Up America contributes up to $30 of federally administered subsidies for initial customer connection costs and covers up to $200 in interest on deferred payments for low-income customers who meet income eligibility requirements in their state of residence.[21] Lifeline programs waive up to 50% of recurring federal subscriber line charges for low-income

users; the state-of-residence must offer a matching reduction in monthly charges for intrastate revenue recovery. Each participating state must specify a means-test to receive program money; customer eligibility must be verified in order to merit FCC certification.[22] Federal subsidies for both programs are again recovered from IXCs according to respective shares of presubscribed lines. In 1993, Link-Up America redistributed $17 million dollars on behalf of 740,000 subscribers in forty-eight states and D.C.; Lifeline assistance helped 4 million users recover $109 million in thirty-five states and D.C. In total, Lifeline, Link-Up, Universal Service, reclassified dial equipment minutes, and carrier common line charges transferred $3.9 billion of revenue to subsidized customers and high-cost exchanges. The Rural Electrification Administration makes hardship loans available to some rural telephone companies at below-market rates (5%). To qualify, the LEC must have a maximum subscriber density of 4/sq. mi., a maximum population of 5,000, and a maximum times interest earned ratio of 3. The gap between the hardship rate and the market has ranged as high as 7.4% (1981).[23] Other loans are also available at market rates.

Under the Americans with Disabilities Act of 1990, common carriers are required to provide nationwide telecommunications relay service to persons with speech and hearing disabilities. No extra fees or charges are permitted for this telephone service. Necessary interstate funds are recovered from each interstate carrier based on its respective share of gross interstate revenues.

State Programs

In addition to participating in the FCC's Linkup and Lifeline programs, some states have instituted additional programs for customer support and high-cost relief. California has the most extensive programs; it supplements FCC support with its own Universal Lifeline Telephone Service ("ULTS") for low-income customers, a High Cost Fund for high cost exchanges. and a Deaf and Disabled Trust for the hearing-impaired and physically handicapped.

Residential users qualify for the ULTS subsidies if their income is less than 150 percent of a determined poverty level. At present, ULTS subsidizes 50 percent of the end-user common line charge and installation cost, supports inside wire maintenance, and grants allowances for telephone equipment; its current size is $300 million. In 1995, lifeline monthly line rates for flat and measured services will be set statewide respectively at $5.62 and $3.00 and installation charges will be set at $10;[24] allowances for inside wire maintenance and telephone equipment will be entirely eliminated. ULTS subsidies were funded by a 6 percent surcharge on all intrastate toll calls, but the surcharge base will soon be extended (at 3 percent) to also include flat and measured local service, Category 2 services, and perhaps inside wire and Yellow Pages advertising.

The High Cost Fund in California has subsidized local exchange companies in remote or mountainous areas that voluntarily pool with Pacific Bell. The purpose of the pool has been to keep company revenues whole whenever Pacific Bell rates are lowered. The High Cost Fund has been funded by carrier common line charges that have been assigned to minutes of switched interconnection by long-distance callers. In 1995, financial support will switch to a 0.5 percent surcharge to be affixed on the extended group of services listed above.

The Deaf and Disabled Trust has subsidized special CPE for the hearing-impaired. It has always been funded by a surcharge directly collected from end-user spending on toll, local, and Category 2 services.

Other states now offer various modifications. Ohio telephone companies finance a connection assistance program for low-income households; support is funded by nonreimbursable expenses from local companies. Like California, Texas established a separate assistance fund for high cost local exchanges. Illinois relies upon voluntary contributions from residential and commercial customers to fund telephone assistance programs for low income households. Vermont charges its residents a direct tax to provide funding for poor customers. The Florida Public Utility Commission is considering the establishment of a universal service fund that would assist low-income households and telephone service providers; money would be distributed in a competitively neutral manner. Wisconsin's subsidies for local exchange carriers will be phased out in 1995. Together, these cost-recovery and universal service mechanisms move subsidy dollars from toll and interconnection services to basic single-line access.[25]

Depending upon the nature of the subsidy and the measurement of costs, measures of the overall subsidy amount differ substantially. On behalf of the USTA, Monson and Rohlfs[26] calculated the excess of switched access and intraLATA toll revenue above incremental costs; they determine that toll callers provide between $18.3 and 21.1 billion in net revenues (depending upon how costs are measured).[27] These results are broadly consistent with a $17.5 billion figure in Leighton.[28] Hatfield Associates[29] compares the price and incremental cost (loop, central office, and interoffice network) per access line for six different population densities to determine a smaller subsidy amount of $3.9 billion; the study contends that the larger Monson-Rohlfs subsidy often goes to defray common costs that are not really incremental.[30] The Consumer Federation of America[31] and Metropolitan Fiber Systems[32] contend that many local customer subscription costs should be treated as common; they estimate that incremental subsidy costs are considerably lower than Hatfield's measure and contend that no access subsidy exists at all.[33]

4. Telephone Penetration Rates

The principal empirical issue related to Universal Service programs is whether present subsidies have generated higher customer subscription rates. As of July, 1994, 93.7% (respectively, 95.3%) of U.S. households have telephone service (access to a nearby telephone).[34] However, 6.2 million households and 15.3 million individuals lacked telephones on their premises; 64% of these are low-income families in metropolitan areas. Household penetration is particularly deficient in the South and other rural/low-income states;[35] 10% of this rural deficiency is due to geographic isolation and 90% to low-incomes.[36] Telephone penetration is particularly deficient among blacks (86.6%), Hispanics (85.5%), and the poor.[37] Penetration among the elderly is at the national average, but lagging among 16-24 year olds.[38] 5.1% of farms and 9.9% of families living outside of any metropolitan service area lack phones.

It is not clear whether subscriber line subsidies improve customer penetration. A 1993 study found that 92.7% of rural households were willing and able to pay the full cost of serving them.[39] Furthermore, telephone penetration in the U.S. increased throughout the 1980s even though subscriber line charges increased simultaneously. Hausman, Tardiff, and Belinfante[40] contend that customer subscription increased due to the lower toll prices that higher subscriber line charges enable.

There are two other remaining reasons why present subsidies might not attract remaining nonsubscribers. First, as many as one-third of non-customers simply do not want service.[41] Second, many households without service are disconnected customers that had higher-than-average toll usage and billings.[42]

5. Local Competition and Bypass

Because minute and line charges exceed marginal cost, business customers and IXCs have invested in dedicated technologies and private networks (wireline, radio, and satellite) that bypass some or all of the public switched exchange. The local carriers have responded with competitive services and capabilities that may preserve or enhance existing network hierarchies.

Originally, IXCs and their largest long-distance callers bypassed local switched exchanges by installing private wire, microwave towers, or competitively priced special access lines provided by the LEC; though profitable to their users, these investments were often economically inefficient. Bypass possibilities increased greatly in the 1980s when fiber and switch costs tumbled and transport speeds increased greatly; competitive access providers consolidated special access traffic on metropolitan area fiber rings and transport facilities.

Network fragmentation has now proceeded further. Sophisticated packet routers/ gateways and distributed high-speed data transport technologies (i.e., fiber distributed data interface and distributed queue dual bus) now permit greater internetworking between independent local area networks over dedicated facilities. Additionally, customers have installed PBXs and software logic for signal compression or error detection that reduce the use of public transport and switching.

Second, very small aperture terminals now enable efficient satellite networking for point-to-point and broadcast applications. Compared with low-frequency C-band generation satellites (6 GHz up/4 down), Ku-band VSATs (14 up/11 down) are considerably smaller, permit stronger signalling, and reduce both interference and licensing problems. These satellite technologies accomodate easier network expansion for long-term and immediate bandwidth needs; long-distance users may now entirely bypass public IXCs and two endpoint exchanges.

Third, local exchange competition is now emerging. As of March, 1995, regulatory commissions in New York, Illinois, Maryland, Michigan, Massachusetts, and Washington have authorized competitors to provide switched local service either statewide or in downtown business areas where traffic can be consolidated. Most entrants will be providers that previously offered competitive long-distance access to business customers; as in Ameritech regions, movements are now underway to unbundle local services further. Cable companies with rights to provide switched voice services include Time-Warner (in Rochester) and Cablevision Systems (in New York City). With broadband auctions complete, PCS providers (including three major consortia) will offer wide-area wireless technologies in the 1800-2000 mHz range that will compete with cellular duopolies and landline service.

However, it is not clear that the public network will fragment further toward the geodesic sphere that Huber predicted.[43] Public carriers now may install centralized data bases that are accessible with out-of-band signaling; this accounts for the return of Centrex service in metropolitan areas[44] and hearkens the beginnings of Bellcore's "Advanced Intelligent Network." Public carriers also may offer powerful competitive "fast packet" technologies

(frame relay, switched multimegabit data service, and automatic transfer mode) that combine out-of-band signalling, centralized intelligence, and virtual private services in "software defined networks."[45] Public data networks now employ processors and data bases that will allow the creation of smart networks; e.g., changing a message from E-mail to FAX, message filtering, and information finding. Customers for most telephone services then may choose among competitive dedicated, public switched, or virtual private services for two-way access and transport; integration and substitutability is possible across competing networks and end-user equipment. The competitive process then embodies both centripetal and centrifugal forces that respectively pull toward integration and fragmentation of network services. Network fragmentation by business users can be particularly unwanted; these subscribers may represent an important component of a critical mass that can enable full service integration and broadband connectivity.[46] With the technical means of avoiding the local exchange that were discussed above, any strategy[47] that attempts to recover subsidies exclusively from interconnection charges to bottleneck local exchanges is problematic.[48]

6. Ideals for Subsidy Recovery

An ideal mechanism for recovering subsidy dollars should minimally distort the outcome of a competitive market. Eli Noam, former regulator in New York, suggests that policy makers keep seven design-neutralities in mind:[49]

1. ***Competitive Neutrality***: Relative market strengths of competitive providers are unaffected.
2. ***Structural Neutrality***: The strategy should not favor or disfavor vertical or horizontal integration.
3. ***Technological Neutrality***: No technology should be favored over others.
4. ***Applications and Content Neutrality***: The strategy should not favor any particular use of telecommunications or message type.
5. ***Geographic Neutrality***: Regional effects should be symmetric.
6. ***Transitional Neutrality***: No provider should carry a disproportionate burden in the transition period.
7. ***Jurisdictional Neutrality***: The system should be integrated into the present federal-state regulatory regime.[50]

From the perspective of allocative economic efficiency, necessary subsidy dollars would be reasonably (if not ideally) recovered through a proportional tax on all personal consumption, income, or property. Under these schemes, no price ratio between any two goods is modified by the tax;[51] consequently, no person's choice between any two products (except for the possible substitution of leisure for work or savings for consumption) would be affected. Whatever theoretical validity these taxes may have, they are politically problematic; it is difficult to imagine that taxpayers would willingly pay, or legislators would attempt to enact, higher general taxes in order to subsidize telephone services.

It may be politically easier to recover requisite subsidies exclusively from users who directly benefit from the existing telephone network (much as highway expenditure is financed by gasoline taxes). Conceivably, this could be done within the existing regulatory framework.

We then shall develop practical *design-neutral* guidelines that symmetrically affect all service choices and do not disproportionately burden any one network provider or technology.

In this constrained context, network efficiency requires that no transport mode is favored or disfavored relative to alternative public or dedicated technologies. Network subsidies would then best be raised by taxing proportionally all consumer purchases of two-way transport services. Policy-makers must then determine a realistic list of providers and services as well as the best means for taxing them.

To omit the most important potential source of choice distortions, the tax base should include sales to consumers from all facilities-based carriers that compete with one another to attract business. Noam[52] offers the following list of facilities-based transport services for taxation: toll and local message unit revenues, wireless revenues, received interconnection payments, special access line charges, virtual services, transport services for enhanced service providers, packet switched transport, Centrex, unbundled central office switching, and monthly telephone subscription charges.

A nondistorting tax can be implemented in either of two ways. First, a fixed percentage sales tax can be added to retail purchases of two-way transport service. If sales taxes are proportional, the price ratio between any two competitive services -- and the resulting consumer choice between the two respective products -- is unaffected. Alternatively, a proportional revenue tax can be assigned to a provider's net transport revenues, which are the difference between gross revenues and interconnection charges paid to upstream suppliers. Since the net revenues of vertically linked transport services sum to retail totals, the two alternative tax bases would not differ.

The tax base can be extended to include resellers that act as middlemen between facilities-based carriers and end-users. Along with facilities-based carriers, resellers can be classified as network providers, in which case their sales revenues to end-users are taxed and their interconnection purchases are not. Alternatively, resellers may be classified, along with retail customers, as network users; their interconnection purchases (or the sales revenues of their input providers) would then be taxed, but their sales to other end-users are not. The second option seems easier.[53] The same resolution would also hold for enhanced service providers (e.g., independent packet networks and information providers) that sell reformatted signals to end-users over leased telephone lines.

Conceivably, sales or revenue taxes, which are based on consumer purchases, can be replicated by taxes on the producer inputs needed to provide customer service; i.e., switching and transport equipment owned by facilities-based providers. However, a sales tax cannot be assessed on network equipment that is already in place; this may therefore disadvantage both market entrants and fast-growing incumbents with disproportionate investment needs. It would also discourage equipment upgrades that improve service quality.

To discourage inefficient deployment of dedicated transport equipment, the suggested revenue or sales tax ideally should also be assigned to end-users based on the imputed value of private services obtained from this equipment. Since this imputation is not practical, the tax here is more reasonably assessed on sales of private equipment. If possible, the tax base should then include outside equipment that can be used to provide two-way transport; i.e., VSATs, microwave towers, and outside wire. However, this modification would involve extending the tax base to include unregulated companies now free of oligations to any regulatory jurisdiction and could be difficult to bring about. Besides outside transport

equipment, policy makers should decide whether to tax inside CPE; this category of equipment would include wireline handsets, FAX machines, personal computers, LAN equipment, inside wire, PBXs, software, videotex, floppy disks, CD-ROMs and drives, videogames, TV and radio programs, movies, VCRs, printers, scanners, voice synthesizers, voice recognition devices, answering machines, and information data bases. Most inside CPE is used to originate, receive, or store information or to enhance basic service; it generally complements two-way transport, which interconnects equipment at (at least) two network nodes. In theory, this nodal equipment can be made exempt or taxed without distorting the transport structure that it complements. Exemption seems more practical; taxing CPE would require a delineation of products that would reach deeply into the computer industry. However, PBXs, LANs, wireless handsets, and compression software can substitute partially for two-way transport; this represents a shortcoming that I believe is realistically unavoidable.

ESPs sell additional services (e.g., information) bundled with two-way transport. To avoid a repressive effect upon the provision of information and other enhanced services, only the transport portion of the bundle should be taxed. When nonintegrated ESPs resell network transport, this tax can be conveniently implemented by taxing their wholesale purchases from facilities-based carriers. As pointed out, this is equivalent to taxing the revenues of the carriers. The latter approach seems easier.

Problematically, integrated transport-information providers could avoid taxes and obtain an unfair tax advantage by imputing "prices" that are respectively lower and higher than market prices (or costs) to transport and service enhancements. The only realistic means of handling this problem (other than taxing the entire bundle) is to require that all transport service be unbundled at nondiscriminatory prices in order to allow competitors access to any presumably low-cost transport. To ensure fair unbundling, some degree of enforced priced parity between different transport services may also be necessary.[54]

Revenue or sales taxes seem preferable to property taxes. Disallowing the impractical measurement of replacement cost, property assessments would need to be based upon historically embedded cost. The resulting tax burden would inefficiently disadvantage new entrants if equipment costs were generally to increase and incumbent providers if costs decrease. Network providers sensitive to these asymmetric effects may ineffectively delay or hasten network investment to take strategic advantage.

Direct profits taxes are problematic as well. By taxing equity payments but allowing debt writeoff, profits taxes encourage inefficient substitution of debt for capital. Furthermore, it is impossible to assign common costs to individual services; a profits tax must then be assessed on all or none of a company's products. This is problematic if an integrated company sells certain services and products (e.g., international services, CPE) outside the suggested tax base.[55]

7. Strategies for Subsidy Recovery

Several authors have set forth alternative methods of generating universal service and high-cost subsidies. Ideas differ on who should pay, who should receive money, and how dollars should be raised and allotted.

Noam[56] suggests that value added taxes be assigned to transport carriers as a flat percentage of their transmission path revenues net of existing universal service contributions

and interconnection charges paid to other carriers. Included among tax contributants are all facilities-based two-way transmission carriers with an FCC carrier identification code and subject to the FCC's Title II regulation. Taxes are not levied upon enhanced service providers, resellers, hardware producers, and providers of private network equipment not subject to Title II.

Egan and Wildman[57] would assign a tax as a fixed percentage of gross revenues earned by any service provider that interconnects with the public switched network. Exempt would be the residential loop service provided by state-certified common carriers with provider-of-last resort obligations. Like Noam, Egan and Wildman would limit the tax base to transport revenues now under FCC jurisdiction.

The Teleport Communications Group[58] offers an option for intrastate funding. All facilities-based common carriers of two-way intrastate service (access and toll call) would contribute to a Universal Service Assurance fund based on respective market share of net revenues for defined services. The size of this fund would be initially fixed at the subsidy level needed to maintain service to each claimed subsidized customer and company, as estimated from the rates established by the incumbent local exchange carrier. Subsidy dollars would be available for each low-income customer in the state and can be drawn on a per customer basis by any chosen local provider.

AT&T[59] suggests that subsidies be removed from access charges and instead funded through surcharges on customer bills rendered by IXCs, CAPs, cellular/wireless carriers, transport resellers, and other service providers. Except for small rural exchanges, subsidies should follow the customer and must be competitively assigned; subsidies should be targeted for core services to needy households that meet specific eligibility criteria. A neutral third party should administer the modified Universal Service Fund.

Metropolitan Fiber Systems[60] would tax all service providers (identified as LECs, CAPs, IXCs, and cellular/PCS providers). A revenue or value added tax is suitable and should be administered by an independent agency. Payments should be made available to eligible poor and special-needs customers via monthly bill credits that can be applied to any chosen provider. Rural exchanges should not generally be subsidized; if implemented, subsidies to high-cost areas should be targeted based on objective criteria (e.g., population density, geography, personal income) and not on LEC actual costs. Reversing an earlier position that held that subsidies should come from general tax dollars rather than network revenues,[61] the United States Telephone Administration[62] now suggests that subsidy revenues be obtained from LECs, IXCs, CAPs, cellular/PCS providers, microwave/satellite services, video providers, and sellers of CPE and Part 68 equipment.[63] Disbursement is made to appointed carriers of last resort or to competitive companies based on their served number of poor and disabled.

MCI[64] supports Basic Universal Service in a competitively neutral manner through an equal percentage assessment on the value added of each service provider. To enable equitable competition, benefits would be distributed in a "provider-neutral" fashion in the form of "virtual vouchers" that can be deployed at user discretion.[65] Wherever deemed appropriate, "carrier of last resort" monopolies would be auctioned off to the highest bidder.

The National Association of Regulatory Utility Commissioners Task Force[66] would impose neutral funding requirements on all service providers that utilize the network. This would include IXCs, CAPs, cable companies that provide voice and data, alternative local providers, wireless providers, enhanced service providers, and competitive LECs. Subsidy

money would be made available in competitive local markets to customers to dispense through service vouchers; otherwise, it would be drawn by the carrier-of-last resort.

Pressler and Schieffer [67] would recover universal service dollars precisely as other NTS costs; i.e., per minute charges for interconnection to local exchanges. Bypass of the switched exchange would be outlawed or taxed.

Under the Australian Telecommunications Act 1991,[68] the regulatory body (AUSTEL) can declare one or several carriers to be universal service carriers; competing carriers may bid for the designation by nominating prospective losses in "net cost areas," which are defined (Sections 301(1) and 301(2)) as those geographic units where avoidable costs exceed revenue foregone from serving the area.[69] Using the avoidable costs method,[70] industry regulators calculate the cost of the universal service obligation; these costs are passed back to participating providers based on share of interconnect time.[71]

8. Conclusions

1. All authors support aid to low-income households, either through direct customer grants, vouchers, tax credits, and revenue payments to local companies. Most authors would allow subsidies to be transferable to any competitive local provider if it agrees to universal service obligations.

2. Rural subsidies are frequently questioned but reasonably defended when scale economies are significant and bypass technologies are redundant. However, high-cost allotments are often held up as areas for incentive-creating reforms. High-cost payouts that pass through actual costs dollar-for-dollar are especially suspect.

3. The Australian auction approach is intriguing but would present difficulties during recontracting where the incumbent provider would have strong advantages. The incumbent may use this power to delay asset transfer and generally inhibit its successor. Additionally, assets are often sunk and therefore not valued in a general market; establishing their worth is quite daunting and invites squabbling and litigation.[72]

4. Most schemes adhere to the principle that cost recovery should be nondistorting, equitable, and more widely assigned than at present. Contributions are recovered (minimally) from all facilities-based carrier sales or revenues rather than from LEC-provided switched services and/or presubscribed lines that can be bypassed.

5. Suggested taxes are usually based as a simple percentage of gross or net (of interconnection charges) revenue. As explained above, these strategies seem preferable to profits or value added taxes.

6. Many schemes recover revenue exclusively from public service providers (facilities-based and possibly resellers) and do not tax competitive private facilities. These strategies then maintain uneconomic distortions and encourage inefficient network fragmentation.

7. Proposals that would tax private network equipment would require legislative/executive approval; they may require considerably more political and administrative effort to clarify what should or should not be taxed and a complicated means of overseeing tax collection. In schemes that limit responsibility to public providers now under FCC-jurisdiction, legislative/executive approval is not necessary; requisite revenue and cost data do seem easier to monitor. There is then a tradeoff between easy administration and neutrality of the results.

8. When service providers purchase interconnection from one another (e.g., LEC and IXC), the resulting payment is taxed as upstream revenue and deducted from the downstream tax base in a net revenue tax. Consequently, net revenue taxes never provide incentives for vertically related companies to merge in order to avoid a tax payment. By contrast, gross revenue taxes assigned to both upstream providers and downstream buyers provide inefficient merger incentives. Gross revenue taxes can be structurally neutral only if assigned exclusively to retail sales to end-users (i.e., sales tax).

9. Most authors avoid taxes on network equipment installed by service providers; this seems wise, since these taxes may discourage network upgrades.

10. No author advocates taxing information providers. This seems reasonable, given the difficulty of defining information services and the disincentive of a tax upon prospective entrants. As pointed out, an integrated provider of information (or enhancements) and transport services can unfairly avoid taxes by overstating the revenue imputation of the tax-exempt information service and understating the imputation for transport. Enforced unbundling with possible price equity may be necessary here.

Bibliography

AT&T Corporation, *Comments, In the Matter of Amendment of Part 36 of the Commission's Rules and Establishment of a Joint Board*, FCC Docket No. 80-286, 1994.

Baumol, W.J., and G. Sidak, "The Pricing of Inputs Sold to Competitors," *Yale Journal of Regulation*, Vol. 11, No. 2, pp. 172-202, 1994.

--- *Toward Competition in Local Telephony*, Cambridge, Mass: MIT Press and the American Enterprise Institute.

Booker, E., "Lifeline and the Low Income Customer: Who is Ultimately Responsible?" *Telephony*, pp. 116-32, May 19, 1986.

Brockway, N., and R. Colton, "What is Universal Telecommunications Service: Standards for Defining and a Definition for 1994," *NARUC Advanced Regulatory Studies Program*, Williamsburg, Virginia, 1994a.

Brockway, N. and R. Colton, "Necessary Steps to the Achievement of Universal Service," *NARUC Advanced Regulatory Studies Program*, Williamsburg, Virginia, 1994b.

Burrows, J. D., P.A. Bernt, and R.W. Lawton, *Univeral Service in the United States: Dimensions of the Debate*, Columbus, Ohio: National Regulatory Research Institute, 1996.

Cain, P., and J.M. MacDonald, "Telephone Pricing Structures: The Effects on Universal Service", *Journal of Regulatory Economics*, Vol. 3, pp. 293-308, 1991.

Cave, M., "Franchising Universal Service Obligations," presented at *USO in a Competitive Telecoms Environment: Expert Symposium*, Magdalene College, Cambridge, UK, December 12, 1994.

Cave, M., C. Milne, and M. Scanlan, *Meeting Universal Service Obligations in a Competitive Telecommunications Sector*, European Commission, 1994.

Cooper, M.N., *Local Exchange Costs and The Need for a Universal Service Fund: A Consumer View*, Washington D.C.: Consumer Federation of America, 1994.

Davis, S., "USO in a Changing Telecoms Environment," presented at *USO in a Competitive Telecoms Environment: Expert Symposium*, Magdalene College, Cambridge, UK, December 12, 1994.

Dordick, H.S., and M.D. Fife, "Universal Service in Post-Divestiture USA," *Telecommunications Policy*, pp. 119-28, April 1991.

Duesterberg, T. J., and P. Pitsch, "Pothole Alert for the Information Superhighway," *Los Angeles Times*, January 11, 1994.

Egan, B.L. and S.S. Wildman, "Funding the Public Telecommunications Infrastructure," *Presentation to the Symposium on Universal Service in the New Electronic Environment*, Washington D.C.: Benton Foundation,, September 1993.

Ergas, H., *Prices, Costs and Subsidies in a Telecommunications Network: The Australian Experience*, Canberra, Australia: Trade Practices Commission, 1994.

Ergas, H., and E. Ralph, *The Baumol-Willig Rule: The Answer to the Pricing of Interconnection?*, unpublished manuscript, Canberra, Australia: Trade Practices Commission, January 1994.

Fischer, P., "USO and Competition in Switzerland," presented at *USO in a Competitive Telecoms Environment: Expert Symposium*, Magdalene College, Cambridge, UK, December 12, 1994.

Fuhr, J.P., "Telephone Subsidization of Rural Areas in the U.S.A.," *Telecommunications Policy*, pp. 183-8, June 1990.

Haring, J., and K. Gordon, *The Effects of Higher Telephone Prices on Universal Service*, Working Paper 10, Washington D.C.: Office of Plans and Policy, Federal Communications Commission, 1984.

Hatfield, D. N., Declaration in *United States of America v. Western Electric Company, Inc. and American Telephone and Telegraph Company*, Civil Action No. 82-0192, 1994.

Hatfield Associates, Inc., *The Cost of Basic Universal Service*, Boulder, Colorado, 1994.

Hausman, J., T. Tardiff, and A. Belinfante, "The Effects of the Breakup of AT&T on Telephone Penetration in the United States," *American Economic Review*, 178-84, May 1993.

Huber, P.W., *The Geodesic Network: 1987 Report on Competition in the Telephone Industry*, Washington D.C.: U.S. Department of Justice, p. 1.3, 1987.

Hudson, H.E., *Universal Service: The Rural Challenge Changing Requirements and Policy Options*, Communications Policy Working Paper 2, Washington D.C.: Benton Foundation, 1994.

Hunt, C.E., *Defining and Costing POTS: A Common Carrier Approach Using the Joint Products Method*, Columbus, Ohio: National Regulatory Research Institute, 1992.

Information Infrastructure Task Force, *The National Information Infrastructure: Agenda for Action*, Springfield, Virginia: National Technical Information Service, U.S. Department of Commerce, September 15, 1993.

Johnson, L.L., *Telephone Assistance Programs for Low-Income Households: A Preliminary Assessment*, Santa Monica, California: Rand Corporation, 1988.

Kahn, A.E., and W.E. Taylor, "The Pricing of Inputs Sold to Competitors: A Comment," *Yale Journal of Regulation*, Vol. 11, No. 2, pp. 226-40, 1994.

Leighton, W., *Telecommunications Subsidies: Reach Out and Fund Someone*, Washington D.C.: Citizens for a Sound Economy Foundation, 1994.

Lipman, A.D., and R.M. Blau, *Petition of MFS Communications Company, Inc. for a Notice of Inquiry and En Banc Hearing, In the Matter of Inquiry into Policies and Programs to Assure Universal Telephone Service in a Competitive Market Environment*, Washington D.C.: Swidler and Berlin, 1993.

Marcus, M.J., and T.C. Spavins, *The Impact of Technical Change on the Structure of the Local Exchange and the Pricing of Exchange Access*, unpublished manuscript, Washington D.C.: Federal Communications Commission, 1992.

McConnaughey, J., "Universal Service Obligation in a Competitive Telecommunications Environment: On the Road Again in America," presented at *USO in a Competitive Telecoms Environment: Expert Symposium*, Magdalene College, Cambridge, UK, December 12, 1994.

MCI Communications Corporation, *Defining and Funding Basic Universal Service*, Washington D.C., 1994.

Milne, C., "Meeting Basic Needs in Telephony," presented at *USO in a Competitive Telecoms Environment: Expert Symposium*, Magdalene College, Cambridge, UK, December 12, 1994.

Mitchell, B.M., *Incremental Costs of Telephone Access and Local Use*, Santa Monica, California: Rand Corporation, 1990.

Monson, C. S. and J.H. Rohlfs, *The $20 Billion Impact of Local Competition in Telecommunications*, Bethesda, Maryland: Strategic Policy Research, 1993.

Nadel, M. S., *Issues Concerning Current Mechanisms of Providing Universal Service in the U.S.*, Washington D.C.: Common Carrier Bureau, Federal Communications Commission, 1994.

National Exchange Carrier Association (NECA), *Comments, In the Matter of Amendment of Part 36 of the Commission's Rules and Establishment of a Joint Board*, FCC Docket No. 80-286, Whippany, New Jersey, 1994.

National Association of Regulatory Utility Commissioners Task Force (NARUC), *Staff Position Statement on Universal Service Principles*, Presentation at the NARUC Meeting, San Diego, California, July 1994.

Noam, E., *NetTrans Accounts: Reforming the Financial Support System for Universal Service in Telecommunications*, Working Paper #648, New York City: Columbia Institute for Tele-Information 1993.

Organization for the Protection and Advancement of Small Telephone Companies (OPASTCO), *Keeping Rural America Connected: Costs and Rates in the Competitive Era*, Washington, D.C., 1994.

Panzar, J.C. and S.S. Wildman, *Competition in the Local Exchange: Appropriate Policies to Maintain Universal Service in Rural Areas*, unpublished document, Evanston, Illinois: Northwestern University, 1994.

Parker, E.B., H.E. Hudson, D.A. Dilman, and A.D. Roscoe, *Rural America in the Information Age: Telecommunications Policy for Rural Development*, Lanham, Maryland: University Press of America, 1989.

Perl, L. J., *A New Study of Economic and Demographic Determinants of Residential Demand for Basic Telephone Service*, Telecommunications Policy Research Conference, Airlie, Virginia, 1984.

Perl, L.J., and J. Falk, *The Use of Econometric Analysis in Estimating Marginal Cost*, Presentation to Bell Canada Industry Forum, San Diego, California, April 6, 1989.

Pressler, L, and K.V. Schieffer, "A Proposal for Universal Telecommunications Service," *Federal Communications Law Journal*, Vol. 40, No. 3, pp. 351-75, 1991.

Riggert, R. L., *Support Mechanisms*, NARUC Staff Subcommittee Issues Workshop, San Diego, California, July 1993.

Schement, J., *Beyond Universal Service: Characteristics of Americans without Telephones*, Presentation to the Symposium on Universal Service in the New Electronic Environment, Washington D.C.: Benton Foundation, September, 1993.

Sievers, M., *Access Subsidies, Long Distance Competition, and the Elimination of the InterLATA Restriction*, Kansas City, Missouri: U.S. Sprint, 1994.

Taschdjian, M., "The USO in a Competitive Environment: Diagnosis and Prescription," presented at *USO in a Competitive Telecoms Environment: Expert Symposium*, Magdalene College, Cambridge, UK, December 12, 1994.

Telecommunications Industries Analysis Project, *What is the Price of Universal Service? Impact of Deaveraging Nationwide Urban/Rural Prices*, Boston, MA: TIAP, July 25, 1993.

Telecommunications Industries Analysis Project, *Redefining Universal Service: The Cost of Mandating the Deployment of New Technology in Rural Areas*, Presentation at the July, 1994 NARUC Meeting, San Diego, California, 1994a.

Telecommunications Industries Analysis Project, *Apples and Oranges: Differences between Various Subsidy Studies*, Presentation at the NARUC Meeting, Reno, Nevada, November, 1994b.

Teleport Communications Group, *Universal Service Assurance: A Concept for Fair Contribution and Equal Access to Subsidies*, Staten Island, New York, 1993.

United States Telephone Association (USTA), *USTA and Universal Service: Meeting Customer Requirements into the 21st Century*, Washington D.C., 1994.

Williamson, O., "Franchise Bidding for Natural Monopolies -- In General and With Respect to CATV," *Bell Journal of Economics*, Vol. 7, pp. 73-104, 1976.

Endnotes

1. The U.S. National Telecommunications Information Administration issued a Notice of Inquiry on Universal Service and Open Access (*Federal Register*, September 19, 1994). The Notice asked for comments regarding the impact of competition on universal service goals, whether universal POTS has been achieved in the U.S., possible expansions of the universal service concept, how universal service should be funded, how much federal/state cooperation is necessary, and how to define open access for telecommunications and information systems. See also McConnaughey (1994).

2. Milne (1994) suggests that the following calls are necessary: calls to deter likely death or a deterioration of medical condition, calls to report witnessed crime, calls to prevent loss of utility or social services, calls to secure employment, and calls to assuage a severe sense of isolation.

3. Milne (1994).

4. Cave (1994).

5. Brockway and Colton (1994b).

6. Cave, Milne, and Scanlan (1994) suggest that in high-income countries, advanced services that reach a penetration level of 50-60% should be included within the universal service obligation.

7. Reviewed suggestions include Brockway and Colton (1994a), Hunt (1992), Hudson (1994), NARUC (1994), USTA (1994), MCI (1994), and AT&T (1994).

8. The continuing pressure to enfranchise low-income families with information technologies will put many of these services on future lists. According to the Clinton administration's Information Infrastructure Task Force (1993), the administration should:

> extend the universal service concept to ensure that information resources are available to all at affordable prices. Because information means empowerment, the government has a duty to ensure that all Americans have access to the resources of the Information Age.

As a corollary goal, the administration would interconnect all classrooms, hospitals, libraries, and clinics by the year 2000. In 1994, Congress considered two pieces of legislation, S. 1822 and HR. 3636, that would have expanded current definitions of basic service.

9. AT&T President Theodore Vail in 1908 initiated the notion that one provider should supply end-to-end telephone service to all requests in a geographic area. In Section 1 of the Communications Act of 1934, Congress charged the newly established Federal Communications Commission with the related mission to regulate:

> interstate and foreign commerce in communication ... so as to make available .. so far as possible, to all the people of the United States a rapid, efficient, Nation-wide, and worldwide ... communication service with adequate facilities at reasonable charges ... for the purpose of promoting safety of life and property through the use of ... communication."

10.For more detail, see Nadel (1994).

11. Using an engineering analysis California data, Mitchell (1990) estimates a long-run incremental cost of $0.00025-.0005 per minute for local calls, $0.00175-0.003 for calls that travel 9-16 miles, and $0.0015-0.003 for longer calls.

12. Local companies may set CCLCs based on individual company cost data or on pooled rates. Pooled companies charge customers the national average carrier common line charge of 1 cent per access minute instead of a higher company-specific amount; e.g., the group average for pooled companies is 3 cents. NECA recovers the difference from direct charges to nonpooled companies.

13. Telecommunications Industries Analysis Project, (1994b).

14. OPASTCO (1994).

15. Local companies with fewer than 200,000 lines in a study area can recover 65% of the incremental amount between 115-150% of national average loop costs, and 75% of the incremental amount above 150%. Magnitudes for local companies with more than 200,000 lines are 10% of incremental amounts between 115-160%, 30% for 160-200%, 60% for 200-250%, and 75% for above 250%. These reassignments are in addition to the basic 25% that Part 36 rules assign to the interstate jurisdiction.

16. Panzar and Wildman (1994). Some facts bear these points out. Average per capita incomes in metropolitan and nonmetropolitan statistical areas are respectively $15,442 and $10,904. Rural REA-financed LECs and primarily urban BOCs respectively average 6 and 130 subscribers/sq. mi. and 6500 and 5,000,000 access lines;

businesses respectively account for 17 and 33% of access lines in the two market groups. Compared with LECs in the voluntary NECA pool, Tier 1 companies (with annual revenues over $100 million) average 30% more minutes of use per line and ten times more minutes of use per central office. Half of NECA LEC central offices serve fewer than 500 access lines; only 5% of BOC central offices are so underloaded. The average monthly loop cost for LECs with less than 1000 access lines was $45.40. For Tier I companies (average size 1,284,500 loops), this amount was $18.90. Comparing rural and urban exchanges, Southwestern Bell found that per minute switching costs were ten times higher in the former.

17. The use of fixed charges superceded the use of minute charges. Because IXCs continue to bill customers with per minute charges, this reduces IXC incentive to presubscribe small users, Riggert (1993).

18. NARUC (1994). Although the dollar amount paid represents 2% of the NTS amount that IXCs pay through access charges and amounts to 52 cents per subscriber line, the (full-transition) fund has grown 60% (from $445 million) since implementation in 1986 and became in August, 1994 the focus of an FCC Notice of Inquiry (*In the Matter of Amendment of Part 36 of the Commission's Rules and Establishment of a Joint Board*, CC Docket No. 80-286, FCC 94-199). Among proposals for reform are fixed or flexible payment caps, complete or gradual elimination of payments to large or nonrural LECs, reevaluation of cost thresholds and percentages for subsidy assistance, and the establishment of vouchers that can be assigned to any competitive local company. NECA (1994) contends that revenue growth is entirely consistent with inflation and the historic increase in the number of subscriber loops.

19. NECA (1994).

20. OPASTCO (1994).

21. This is particularly beneficial to poor households, who are more likely to move in any year (Brockway and Colton (1994b).

22. Participation could be contingent upon reported income or participation in food stamps or a welfare program.

23. Fuhr (1990).

24. Compared to the previous structure of financial support, these new arrangements regarding monthly rates and installation charges will be more generous in some company service territories.

25.Including the subscriber line charge of no more than $3.50 per line, monthly residential access prices for flat-rate service range from about $12 (New York, California) to $27 (West Virginia); the national average is about $18-19. Most states have made available residential service options that are priced lower than one-party, unlimited, flat rate service; the national average monthly charge is $6-7. Related incremental costs to provide customer access range from $18-$24.

26. Monson and Rohlfs (1993).

27.Using *embedded* costs, Sievers (1994) calculates that customers of long-distance companies pay $14 billion to local exchange customers, principally through interconnection charges for interLATA calls.

28. Leighton (1994).

29. Hatfield Associates (1994).

30.Hatfield's figure more accurately represents the size of the universal service burden carried by subsidizing local loops. Chip Shooshan (*Telecommunications Reports*, 1/23/95, p. 23) correctly identified the higher figure as the amount necessary to make local companies whole during the transition to competition; this would include nondepreciated capital and other common costs.

31. Cooper (1993).

32. Lipman and Blau (1993).

33. Granting this assumption, economic efficiency is maximized when common costs are allocated principally to the most inelastic service, which econometric studies generally confirm is customer subscription Johnson, (1988). Therefore, subscription prices would efficiently carry most of the common cost burden.

Perl (1984) estimated a demand elasticity of access to be -0.04; Gordon and Haring (1984) find an even smaller amount. Cain and MacDonald (1991) find that poor households generally have a higher price elasticity, but the effect goes to zero when local companies offered local measured service as a fallback option. Hausman, Tardiff, and Belinfante (1993) estimate the elasticity with respect to the basic access price of -0.005 and the installation charge of -0.0206.

34. These figures compare favorably with 91.4% and 93.8% in 1983, roughly 80% in 1960, and less than 50% in 1945.

35. Dordick and Fife (1991).

36. Parker, et al., (1989) p. 67. The isolation factor may decrease considerably with the advent of wireless technology.

37.Telephone penetration in households with less than $5000 in annual income is 76.4%. Telephones do not appear in roughly 31% of families on food stamps, 35% on public assistance, 28% on welfare, 53% in Indian reservations, and 50% if female-headed and living below the poverty line Schement (1993).

38. Perl (1984), Johnson (1988).

39. Telecommunications Industries Analysis Project (1993).

40. Hausman, Tardiff, and Belinfante (1993).

41. USTA (1994).

42. Dordick and Fife (1991).

43. "The inexorable trend is ... to move switching out toward the end user." Huber (1987, p. 1.3).

44. Hatfield (1994).

45. The phrase "virtual private" refers to public provider services that function as though they were entirely private. "Virtual privateness" is made possible through software that can be installed at strategic points in the public network.

46. In contrast to the U.S., Japan, Singapore, and France have undertaken massive capital investments in order to modernize their public networks, with the eventual aim of full integration to a broadband superhighway.

47. e.g., Baumol and Sidak (1994), Kahn and Taylor (1994).

48. For criticism of the Baumol-Willig rule, see Ergas and Ralph (1994).

49.Noam (1993) Design-neutrality is still a limited objective. Ideally, no customer would have an incentive to reduce overall usage of the network as well. This additional property cannot be achieved if prices on elastic demands are increased.

50. Noam (1993) also delineates five "friendlinesses": *political*, where asymmetric rate shock or windfall is avoided; *collection*, where targeted revenue collection is stable; *administrative*, where the process is kept simple; *integratability*, which preserves existing universal service schemes; and *productivity*, where incentives for production efficiencies are maintained.

51. This is because proportional sales taxes increase both prices by the same percentage, while a personal income or property tax affects no price at all.

52. Noam (1993).

53.This is for two reasons. First, the number of sales transactions between end-users and resellers is considerably greater than the number of transactions between resellers and facilities-based carriers; therefore, the second option seems considerably less bureaucratic. Second, some "resellers" only resell part of the service to other end-users; a tax collector would be required to impute a tax for self-use under the first option, but not the second.

54. I wish to thank Henry Ergas and Eli Noam for helpful discussion on this point.

55. Some of these problems also affect European-stsyle value added taxes, which allow tax deductions for nonlabor and noncapital costs that can sometimes be common.

56. Noam (1993).

57. Egan and Wildman (1993).

58. The Teleport Communications Group (1993).

59. AT&T (1994).

60. Lipman and Blau (1993).

61. Booker (1986).

62. USTA (1994).

63. Equipment taxes are also advocated by the Telecommunications Industries Analysis Project (1994). The group also suggests excise taxes and the use of PCS auction money.

64. MCI (1994).

65. Under a "virtual voucher" plan, customers would choose their preferred local service provider, which could draw an amount from an independently managed pool that is equal to the voucher amount.

66. NARUC (1994).

67. Pressler and Schieffer (1991).

68. Ergas (1994).

69. Taschdjian (1994) suggests a Dutch auction in high-cost areas where regulators slowly raise their subsidy per served customer. Bidding stops when a designated price is selected.

70. Cave, Milne, and Scanlan (1994).

71. Cave (1994); see also Fischer (1994); Davis (1994).