Subsidies, the Value of Broadband, and the Importance of Fixed Costs

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Abstract

This paper uses individual level data on consumers' willingness to pay for broadband to compare two different approaches to subsidizing broadband, namely subsidies for consumer usage and subsidies for investment in unserved markets. The results show that because of the presence of fixed costs in expanding broadband into new markets, the efficiency costs of a subsidy to broadband usage are likely to be much larger than of a subsidy to broadband investment in unserved markets. Subsidizing the price in existing markets tends to attract only marginal users with low values on the product. The consumer gains from such a subsidy are significantly lower than their cost at the time that the subsidies are introduced. Subsidies to investment in new markets, however, give broadband access to people with very high valuations. Preliminary calculations indicate that the welfare gains from such a policy may be several times higher than its revenue cost. The geographical incidence is much different between the two policies. The benefits from the usage subsidy tend to be distributed across 18-20 states. The benefits of the investment credit tends to be concentrated in only a few.

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I. Introduction

One of the new technologies identified by policymakers and the general public to be important in the coming decade is broadband (high-speed) Internet access. Currently broadband is mainly available through cable but there is an increasing presence of DSL and satellite broadband available (Scafidi and Zohar, 2000). Broadband typically allows users to access the Internet at speeds up to 100 times faster than with a traditional dial-up modem. Thus far, broadband has grown rapidly but still accounts for a relatively small fraction of Internet connections (Mines et al., 1998; Strategis Group, 1999). It is often asserted that that once broadband becomes ubiquitous, the nature of activities conducted on the web will fundamentally change as people shift a variety of "high bandwidth" activities to the Internet such as watching television and movies, taking courses, and the like.

Fears that this new technology will leave some people behind or form the basis of an important digital divide have lead numerous policy makers both in the U.S. and abroad to consider ways to accelerate the spread of broadband. Others have made the argument that there may be positive indirect network externalities to the spread of broadband such that if there are enough broadband users, suppliers will create new forms of content that will attract even more broadband users (see the discussion of Cremer, 2000). The policies proposed (or, in some cases, enacted) to accelerate broadband have included subsidies to Internet adoption in public schools, subsidized prices of broadband access for all users, investment tax credits for broadband providers to expand service into rural and under-served markets, and moratoria on state and local taxation of Internet access.[1]

There has been little empirical work, however, evaluating the welfare gains from broadband or the impact that subsidies would have on consumers. This paper extends recent work in economics that attempts to value the welfare gains from new products using market price and quantity data and and an assumed functional form for the demand relationship.[2] It shows how survey data on consumer willingness-to-pay (WTP) can be used as an alternative means of deriving market level demand curves and calculating welfare gains. It then compares the costs and benefits for the two primary approaches for subsidizing broadband—subsidizing usage (the demand side) and subsidizing investment (the supply side).

Because there are fixed costs associated with entering new markets, the gains from the investment subsidies can be particularly high as a share of the revenue cost of the subsidy as compared with a usage subsidy. A subsidy to usage tends to induce

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[1] The subsidy program for public schools is known as the e-rate program and its effect is analyzed in Goolsbee and Guryan (2001). Calls to lower the price of broadband access have come from many sources including Bill Gates (Gates, 2001). Actual programs to subsidize broadband have been restricted to small pilot projects such as the Blackburg Electronic Village project or the Launceton project in Australia (see Yaukey, 1997 or Pacific Access, 2001). Several proposed bills would give tax credits for introducing service to rural and under-served markets. The Broadband Internet Access Bill of 2001, for example, would give a 10 percent credit for existing broadband or a 20 percent credit for next-generation broadband. The moratorium on Internet access taxes was part of the Internet Tax Freedom Act and its impact on Broadband is analyzed in Goolsbee (2001).

[2] Examples of such work include Trajtenberg, 1989; Bresnahan and Gordon, 1997; Hausman, 1997, 1998, 1999; Petrin, 1999; Nevo, 2000; Goolsbee and Petrin, 2000. Estimates of the demand for broadband include Varian (2001) and Rappoport and Taylor (2001).

adoption by people with low valuations of the new product, and its revenue cost exceeds the gain in consumer surplus. An investment subsidy potentially extends the product to users with particularly high valuations that previously did not have access; therefore, its efficiency cost is much smaller as a share of revenue. Although the absolute number of new users is smaller with the investment subsidy than with the usage subsidy, the welfare gains are approximately four times greater. The paper also shows that the incidence of the two subsidies is fairly similar except along one important dimension: geography. The gains from the usage subsidy is spread across almost all states that have broadband access whereas the gains from the investment subsidy are concentrated in the few states with marginal markets (i.e., markets where entry is induced by the investment subsidy). A welfare-enhancing investment subsidy exists in only a handful of states at the time that the WTP sample was collected.

The paper proceeds in five sections. Section II describes the issues raised in calculating the welfare gains from new products and why extreme observations are so influential on the results. Section III uses the data to calculate the consumer gains from broadband under various assumptions. Section IV analyzes the role of fixed costs in the spread of broadband and how they are relevant to the subsidy issue either in existing markets or for entering new markets as well as the incidence of subsidies. Section V provides the policy conclusion.

II. The Basics of Valuing New Goods

The typical analysis of consumer welfare from a new good involves computing the area underneath the demand curve and above the market price as in figure 1. This approach also makes calculating the impact of a subsidy quite straightforward since the subsidy simply lowers the price in a market, allowing one to calculate the increase in consumer surplus and compare this calculation to the revenue cost of the subsidy.

While this type of analysis is straight forward in principle, the problem in practice is that one typically observes data that are rather far removed from the "choke" price at which demand would go to zero. This makes it difficult to estimate the gains for precisely those people who are most important for the overall gain. Consider the alternative demand curves in figure 2. If one is estimating these demand curves with observed data from the equilibrium range, either curve is likely to fit the data fairly well. The problem is that these two demand curves have radically different implications for the implied consumer surplus. In the case of the linear demand curve, for example, the consumer welfare at Market P is the triangle A. For the log demand curve, the area under the demand curve adds the B area, which becomes infinite. By choosing one curve over the other, the researcher dramatically affects the answer,but either one seems to fit the data well in the observed range.

This problem of the choice of functional form plagues almost all work in this area. It is important to note, however, that the main differences in the computed welfare of the demand curves, if we think of them as being composed of a series of different people with declining reservation values, come exclusively from the small number of consumers with very high valuations. The importance of these high values has been noted in previous empirical work by Petrin (forthcoming) or Goolsbee and Petrin (2001).

This is important for calculating the impact of broadband subsidies because if such subsidies simply lower prices in existing markets, the estimated impact on consumer surplus to less uncertainty than if the subsidies introduce new customers who may have very high valuations. It should be fairly clear, however, that the latter policy will tend to induce much larger welfare gains than the former.

An alternative to using demand estimates from market data and then imputing the choke price by extrapolating the functional form to the y-axis is to use Willingness-to-Pay data (WTP) where consumers are asked to give their reservation prices directly. If consumer report truthfully, these data can be used to compute the true demand curve and to calculate the consumer surplus. Since everything hinges on consumers reporting truthfully, it is important to check the performance of these computed demand curves in the equilibrium range to see if they give plausible values. Note, though, that the usual presumption of the superiority of demand curves estimated from market data is much less pronounced in the case of valuing new goods because in this calculation, one is extrapolating the data beyond the applicable range to solve for the choke price. If the WTP demand curves perform acceptably in the equilibrium range, their values close to the choke price are certainly no worse and possibly much better than simple extrapolations of functional forms.

III. Valuing Broadband

<u>The data.</u>

To estimate the demand curves based on WTP data, I use individuals' reservation prices derived from surevey responses on willingness to pay for broadband in the surveys of Forrester's *Technographics 1999* program. These are the same data used in Goolsbee (2001). Forrester is a leading market research company that studies the information economy. It conducts an annual survey of nearly 100,000 people, asking about their usage of various products and obtaining various demographic information.[3] . The survey question relevant to this study was one that asked consumers how much they would be willing to pay (in dollars per month) for high-speed Internet access that is up to 100 times faster than that obtained with conventional dial-up modems. Their answers are of the form "Less than $5", "$5-$15", "$15-25", and so on up to "$65+." I sum these individual responses to get a market demand curve in each of the top 70 metro areas. It is important to note, of course, that this calculation necessarily reflects demand at the time of the survey in 1998. Since the demand for broadband has grown by some estimates by more than 100% per year, the willingness to pay is likely to have increased substantially since this survey (Pepper, 2001). This caveat does not affect the estimated results, but it does mean that the losses from not serving a market are, in reality, likely to decline as the growth of demand overwhelms the fixed cost burden and entry ensues.

In addition to the WTP information, the Forrester data also provides information about income, education, age, location and a variety of other information on the respondents. This information is used to compute the incidence of broadband subsidies. At the time of the sample, residential DSL was virtually non-existent (see Gilett and Lehr, 1999) so cable modems were the only source of broadband. The cable companies

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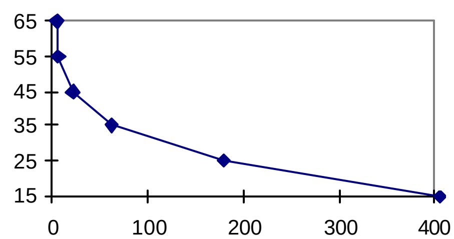
3 More detail on the Forrester survey can be found in Bernhoff et al. (1998) or Goolsbee (2000)

themselves were typically monopolies in their franchise areas. The data on cable modem availablity is derived from *PC World* (1999).

Computing Demand Curves

The number of respondents in a market who say they would be willing to sign up for high speed access at a series of prices ($65, $55, $45, and so on) are summed in each of the 70 most populous television markets in the U.S. (together accounting for about 75 percent of the total population). The sample is restricted to only those people reporting reservation prices of at least $15 per month so as to keep observations far from the equilibrium prices from influencing the estimated shape of the estimated demand curve. An example of the demand curve for the San Francisco area is plotted in figure 3. There are 70 such demand curves, one for each market. Price per month is on the vertical axis and the number of respondents who would purchase broadband at that price is on the horizontal axis. Using the population data in Nielsen (1999), I will assume there are about 1200 U.S. households per survey respondent.

FIGURE 3:
DEMAND CURVE FOR BROADBAND (SAN FRANCISCO AREA)



The first thing to note from this graph is that the demand curve is clearly not linear. The left tail is much steeper than the lower portion, indicating that there are a few people who seem to value broadband highly. In Goolsbee (2001), I estimate quadratic inverse demand curves for each market as being the best fit (thought the results changed little using a log linear specification with a cap at $65 per month). (I ignore the household's income.) The estimated elasticity of demand for each market at a price of $40 per month is listed in column 1 of table 1. I exclude the last 20 markets from the table to save space. The R^2 was high (about .9) in every market. In San Francisco, the estimated elasticity is –2.65. The estimated price elasticities range from –2.15 to –3.76 in the other markets. The regression coefficients for each market can be found in Goolsbee (2001).

Checking the Demand Curve at Market Prices

As these demand curves will form the basis of computing the value of broadband and comparing alternative subsidy regimes, it is important to verify that they are accurate at least in the area where they can be verified. This is accomplished in two ways.

First, the data appear to be internally consistent in the sense that the actual take-up rates in markets where broadband is available at the time of the sample (at prices between $40 and $50 per month) seem to match the implied take-up rates in the WTP data. Actual take-up in the served markets was about 2.2% in the Forrester data at the time of the survey. Other sources have suggested that the take-up rate was slightly higher—3 to 5 percent—because not all people in any given area have access to broadband). The reservation price data suggest that among Internet users who live in places without broadband access, about 4.7 percent report they would be willing to pay $35-45 per month and about 2.0 percent report that they would be willing to pay more than $45 per month for broadband access.

The second form of verification compares the implied elasticity at market prices to the elasticity found elsewhere in the literature. Conventional analyses of the demand for broadband have analyzed the adoption rate of broadband in response as a function of price. Some have compared price differences between cities (Kridel et al., 2001), some between cable and non-cable subscribers (Goolsbee, 2001), and some have used randomized experiments with prices to estimate an elasticity (Varian, 2000). Again, these demand elasticities are valid only in the range of the observed data and can be converted into a consumer welfare estimate only by an assumed extrapolation. These estimates have indicated a fairly elastic demand for broadband, ranging from –1.5 to –3.0, close to the implied elasticities in the WTP demand curves.

It is important to note, of course, that as interest in broadband grows following this sample, the elasticity of demand could increase or decline (in absolute value), and such changes will affect how the results found in this sample apply to the present. New customers that adopt the service could be those who are very price sensitive, leading to higher price elasticity.. Alternatively, the quality of the product could improve, or people could become so accustomed to high speed that they could then have a very low price sensitivity of demand.

Potential Subsidies

Subsidizing Current Broadband Usage

A natural approach to increasing broadband usage would be to subsidize each user directly.Such a subsidy is , by definition, restricted to those markets where such service exists. The problem with providing such a subsidy is that people not currently subscribing to broadband service at the market price are precisely the people who do not value it very highly. In markets where the service already exists, those consumers do not purchase it are simply indicating that their value does not exceed, say, $40 per month. In figure 1, a subsidy from the government reduces the price of the good from Po to Ps. The added consumer surplus from this policy is the area A. Unfortunately, the revenue cost of providing this benefit is be A plus B. Unless demand is perfectly inelastic or there are network externalities, this subsidy will cost more than the benefit it generates.

To apply this lesson to the case of broadband, I use the demand curves estimates above and then reduce the price of service from $45 to $35 in markets where broadband was available at the time of the sample. In these markets, the total predicted number of customers rises from 366,000 to 890,000. Taking the simplest piecewise linear demand curve between the two points, the added consumer surplus across the markets from this subsidy totals about $90 million per year. To translate this into Net Present Value (NPV) terms, I assume a discount rate of 10 percent and an expected customer life of 4 years.[4] The NPV of consumer surplus from the subsidy is $315 million. The revenue needed to pay for the subsidy, however, is at least $10 a month for every customer or almost $110 million per year (or $385 million in NPV).[5] In other words, the welfare gain is only about 80% of the cost of the subsidy in this standard case.

To justify such a subsidy would require a positive externality equal to at least 20 percent of the direct consumer surplus. In fact this is an underestimate because the government must raise funds through distortionary taxes, the marginal cost of government funds will be greater than the actual revenue outlay. Typical estimates the costs of such distortions are about 25-35 percent on the margin (see Ballard, et al., 1985),and some specific taxes on telecommunications products may have much greater marginal efficiency costs (see Hausman, 1998; Goolsbee, 2001).

<u>Subsidizing theFixed Costs of Service</u>

The analysis of a conven~~tional subsidy, such as~~ that shown above,does not address the supply decision, namely whether and when to provide a market with broadband access. The nature of broadband, particularly cable modems, is such that the costs have two distinct components, a marginal cost component that must be incurred for every additional customer[6] that buys broadband service and a fixed cost component that must be incurred just to offer broadband in an area. More detail on the structure of residential broadband costs can be found in Abe (2000), Azzam and Ransom (1999), or Maxwell (1999).

The fixed costs are costs that are shared among more than one customer. The largest of these, for the cable companies, are the costs of upgrading the head-end equipment, the initial marketing and customer acquisition costs in a market, the cost of upgrading the traditional coaxial cable lines to higher-capacity, digital two-way Hybrid Fiber-Coaxial (HFC) lines, the cost of operating a system wide maintenance system, and

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4 I choose such a short lifetime both because there are rapid innovations in this industry and because the potential competition from DSL might have been expected to cut into future profits when it arrived (after the current sample).

5 This is assuming a competitively priced supply with constant marginal cost. In reality, the monopoly supplier's reaction to the subsidy must also be considered but is irrelevant for the point at hand.

6 Marginal costs would include things like the cable modem and installation for the customer, upgrading or laying new line to the individual customer’s home, and any maintenance inside the home.

the costs of setting up a billing system that can allow more complex billing and monitoring than the typical cable system. These costs can be substantial and will influence whether a firm decides to enter a market. If the expected profits from a market do not exceed the costs of investment, the providers will delay or perhaps bypass entirely the market in question.[8]

Goolsbee (2001) shows the importance of this factor in an analysis of the effects of taxation on broadband access. If applying a tax reduces the cash flows that the supplying firms receive from the market to less than the fixed costs (and if they were above the fixed costs before the tax), then, in essence, the tax is much more destructive than in a conventional calculation because it destroys all of the potential consumer surplus arising from the new product in the bypassed market. By similar reasoning, a subsidy to broadband usage, although an source of consumer gains in markets that already have service, may increase firm profits sufficiently to induce them to enter previously bypassed markets and generate large consumer gains. In some sense, these are precisely the gains one wants to get in that they are the untapped consumers with very high valuations as opposed to the marginal consumers with low valuations that are only getting induced to buy the product because the price is low.

This consideration raises a completely different mechanism to stimulate broadband, namely, subsidizing the expansion of service into previously unserved areas by reducing the fixed costs of entering a market while doing nothing to affect the marginal costs. Such a policy would, in theory, have no impact on the prices of the service but could influence the number of markets that suppliers choose to enter.

To get a sense of how much more efficient such a policy might be relative to a subsidy to broadband usage in existing markets, I return to the demand estimates of Goolsbee (2001) shown in table 1. The last two columns present the annual producer and consumer surplus estimates for each of the markets.[9] Estimating a probit regression of the decision of the cable company to offer broadband access in a market on a constant term and the estimated producer surplus in the market yields an implied fixed cost (by dividing the constant term divided by the coefficient on producer surplus and scaling it up by the number of households per respondent and multiplying by 12 to turn the monthly

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8 In Goolsbee (2001) I test whether market density appears to change the estimated fixed or marginal costs, as predicted in other work (see Gilett and Lehr, 1999). Including the density in the probit regression does not yield a positive nor significant coefficient (meaning entry is not easier in higher densitiy places, conditional on being in the biggest 70 metro areas). Similarly, prices do not vary across the dense and non-dense markets so there is no good evidence that it effects either type of cost in this sample.

9 These calculations were made using the demand curves for each city based on the WTP data and the cubic demand curve and assuming a constant marginal cost per customer. The paper then derived the optimal price to charge in each market and the implied producer surplus and estimated the implied fixed cost using a Probit on the entry decision as a function of the producer surplus from each market. See Goolsbee (2001) for details.

number into an annual number).[10] In other words, it calculates the level of annual producer surplus required to raise the index above zero and to thereby induce entry. Table 2 shows that the results of this probit estimate of the implied fixed cost is an annual stream of $4.1 million or about $14.4 million in NPV terms. The model predicts that 23 of the markets **in Table 1** were sufficiently profitable to warrant entry at the time of the sample.

Assume that the government gives a 20 percent investment subsidy to reduce the fixed costs of expanding service to unserved markets in the spirit of the Broadband Access Bill.[11] This would entail a subsidy of about $2.9 million (i.e., 20 percent of $14.4 million) in each market that takes up the subsidy. The cutoff for a firm to decide to enter a market will now be reduced. The subsidy is equivalent to reducing the entry threshold by 20%, from $14.4 million in NPV to $11.5 million in NPV (i.e., $4.1 million to $3.3 million in annual profit). In five markets from Table 1, profits were too low to induce entry without the subsidy but sufficient if the subsidy were in place—Nashville, Portland, Raleigh, Pittsburgh and Austin.

If the government can tailor the subsidy to only those areas predicted to have no service (i.e., not have to pay for subsidies to the 23 markets predicted to have service already), the cost of this subsidy will be only $14.4 million in the five marginal markets. If the subsidy were extended to all markets, it would then be expanded to 28 markets for a total cost of about $80 million. In the new markets, however, the added consumer surplus will be quite large, unlike in the direct subsidy case. Rather than adding marginal users, the fixed cost subsidy brings service to otherwise neglected markets and the consumer surplus for the initial users there is very high. The total consumer surplus added from this subsidy is about $60 million per year or $210 million in NPV.

To summarize, subsidizing usage of broadband yields a gain of only 80 percent of the cost of the subsidy. Subsidizing investment in new markets, on the other hand, would cost $14.25 million (or $80 million if it could not be restricted only to the unserved markets and had to subsidize the fixed costs in already served markets as well) and would generate $210 million in NPV consumer surplus, a gain 2.4 to 14 times greater than the cost (again subject to the marginal efficiency cost of raising tax revenue as described above).[12]

The actual number of users increases more with the conventional usage subsidy, but net welfare increases much less. The average consumer surplus gain per new customer is only $5 per month (i.e., about $60 per month) in the conventional case. The

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10 The entry decision data comes from PC World (1999) and measures those metro areas where cable modems were widely available at the time of the survey. I look only at the cable supply decision because DSL was generally not available to home users at the time of the sample.

11 Note, though, that this is not a prediction for the effects of that bill since I am not looking at rural areas, only at medium sized cities that currently do not have access.

12 Obviously with the demand curve for broadband shifting outward as rapidly as it was doing in practice at this time, the subsidy would cost more since more markets become marginal each year as they get bigger. The welfare gains from the subsidy get larger, too, though, since the customers in the new markets receive bigger benefits from access to broadband that they did not have before.

average consumer gain among the new customers in the fixed cost subsidy is over $50 per month (about $620 per year). This dramatic difference exists because the value of the service to the people induced to buy the service is so different in the two cases.

One caveat in this analysis is that the fixed costs of entering a market may be falling over time due to technological progress in the electronics required to upgrade the head-end electronics, and the like. Forecasts from a report by McKinsey and JP Morgan (JP Morgan, 2001) predict costs to fall almost by one-half over the next four years (though part of that is a reduction in marginal costs from reduced cable modem prices). Obviously this would affect which markets are marginal and what the implied profits are from entering.

The Incidence and the Politics of Broadband Subsidy Policy

The final issue that is worth considering, given the potentially large gains from targeted fixed cost subsidies relative to other types, is why this approach is not more popular. It may partly be due to the geographical incidence of the subsidy. Table 3 shows distribution of the consumer across states under the two plans. Clearly, although the conventional subsidy has smaller gains, they tend to be spread across all the markets with broadband. Eighteen states realize some gains from the usage subsidy and about twelve gain substantially. These 12 states also tend to be states will large populations. With the fixed cost subsidy, the gains are concentrated only in the few markets where the subsidy induces entry. In this example, there are only five primary beneficiaries (NC, OR, PA, TN, and TX). These are the locations of the five metro areas that added service with the subsidy (Washington includes a small number of people in the Portland, Oregon television market which is why the table shows it having a minor gain in users). This geographic concentration of users may reduce the political coalitions in favor of the fixed cost subsidy.

On dimensions other than geography, the differences are very small. Table 4 provides the demographic information for the people induced to buy broadband by the usage subsidy in existing markets (column 1) and compares it to the demographics of the new adopters in the case of the fixed cost subsidy (column 2). The data show that the two groups of adopters look very similar by most measures. The new adopters in the fixed cost subsidy are slightly younger, slightly less likely to own their own homes and slightly higher income than the adopters from the usage subsidy. All of the values are very close, however, and education levels are almost identical.

Conclusion

This study provides an analysise of various policies to subsidize broadband adoption ,using estimates of individual consumers' willingness to pay for broadband in different areas. In particular, it compares a subsidy to usage in existing broadband markets with a subsidy for investment in unserved markets. The results indicate that subsidizing usage generates more adoption than subsidizing fixed costs does, but that the consumer welfare gains are much smaller -- on the order of 50% -- and the revenue costs much higher with the usage subsidy, By definition, subsidizing usage tends to attract marginal customers that do not value the new product very highly. On average, such a subsidy tends to cost significantly more than it generates in consumer surplus. The subsidy to investment avoids the problem of low valuation consumers by inducing entry into unserved markets where the new adopters have very high valuations. Preliminary calculations suggest that the consumer welfare gains are as much as 14 larger than the revenue cost of such a subsidy.

Although the efficiency of such a subsidy is substantial, the incidence tends to be highly concentrated in a small number of geographical locations in a way that the general usage subsidy is not. This is because the only beneficiaries in the investment subsidy case are those living in marginal markets where the subsidy induces broadband entry. Although the gains from a general usage subsidy are small, they tend to be spread across all markets that currently have broadband. Other than geographic differences, though, the demographics of the beneficiaries tend to be quite similar across the two policies.

This lesson should not be lost on regulators either. Any policy aimed at increasing broadband should address the fact that increasing usage in markets where the product is available at a given price are likely to increase consumer well-being by less than equivalent policies that aim to expand broadband to customers that cannot get it yet at any price.

Figure 1: Subsidies for Broadband Usage

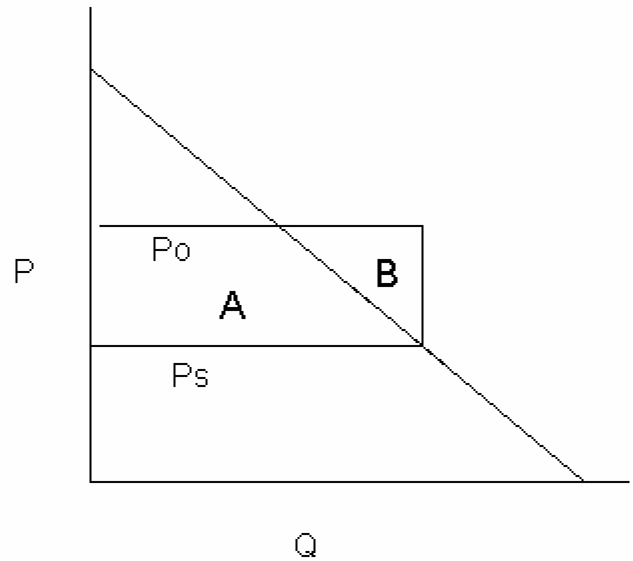

Figure 2: Estimating Welfare Gains Using Market Data

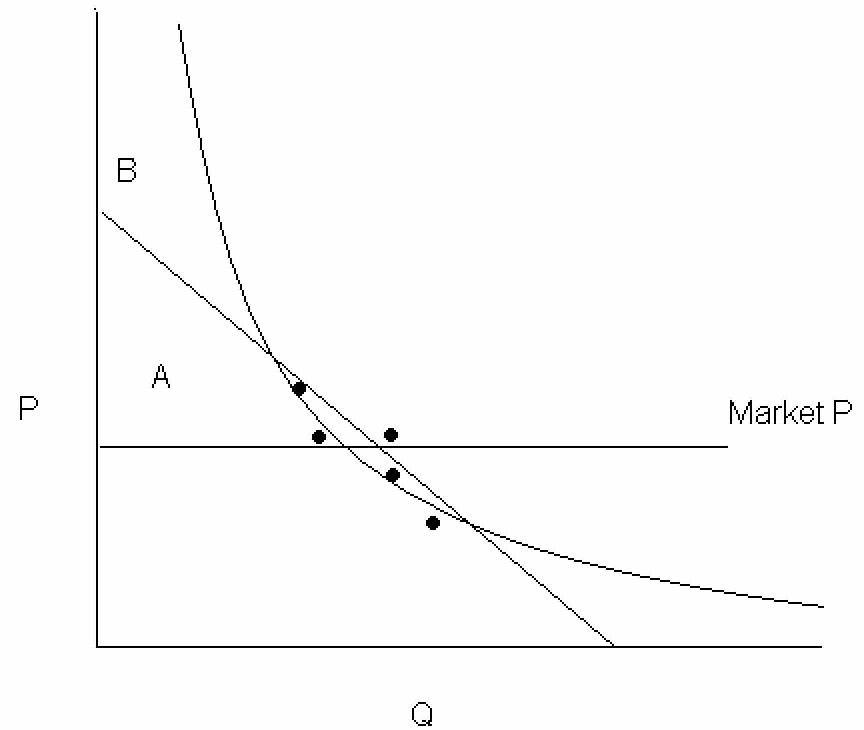

Table 1: Price Elasticities of Demand and Consumer and Producer Surplus Estimates By Metropolitan Area {**YEAR??]** (in $000s)

MSA	Estimated Price Elasticity (P=$40/mo)	Estimated Annual Producer Surplus	Estimated Annual Consumer Surplus
NYC	-2.82	22838	74348
LOSANGELES	-2.67	18531	59465
SANFRAN	-2.65	14745	47270
WASHDC	-2.61	13578	43293
CHICAGO	-2.59	12551	39899
PHILLY	-2.75	12182	39390
DALLAS	-2.59	10072	32047
BOSTON	-2.81	9231	30029
SEATTLE	-3.07	7761	25906
ATLANTA	-2.44	7180	22425
PHOENIX	-2.30	6803	20856
DETROIT	-2.87	6760	22155
HOUSTON	-2.60	6290	20040
SACRAMEN	-2.66	6290	20167
MINNEAPO	-3.04	5817	19337
DENVER	-2.50	5497	17292
SANDIEGO	-2.90	5182	17019
STLOUIS	-2.47	5064	15880
BALTIMORE	-2.82	4825	15693
MIAMI	-2.49	4320	13573
CLEVELAND	-2.96	4318	14250
MILWAUKEE	-2.54	4211	13315
TAMPA	-2.89	4200	13753
NASHVILLE	-2.64	3940	12604
PORTLAND	-2.74	3848	12403
RALEIGH	-2.44	3781	11826
PITTSBURGH	-3.68	3609	12660
AUSTIN	-2.30	3321	10201
COLUMBUS	-2.96	3174	10497
SALTLAKECITY	-2.99	3053	10100
CINCINNATI	-2.63	2868	9148
INDIANAPO	-3.45	2843	9783
ORLANDO	-2.90	2797	9159
NORFOLK	-3.01	2691	8910
HARTFORD	-2.31	2548	7816
BUFFALO	-3.08	2391	7972
WESTPALM	-2.78	2275	7389
ALBANY	-3.60	2260	7881
GRANDRAPIDS	-3.24	2097	7107
CHARLOTTE	-3.06	2064	6877
PROVIDENCE	-3.05	1980	6595
SANANTONIO	-2.64	1973	6303
DAYTON	-3.22	1961	6624
NEWORLEAN	-3.31	1908	6513
RICHMOND	-3.02	1875	6248
TOLEDO	-3.27	1801	6132
ALBUQUER	-2.71	1792	5774
KANSASCITY	-2.15	1792	5376
LANCASTER	-3.50	1659	5720

Source: Estimates using quadratic demand curves in Goolsbee (2001). These are the top 50 markets, the next 20 markets are excluded to conserve space but are included in the estimates. The elasticity is calculated at a price of $40 per month. The producer and consumer surplus calculations are computed as described in the text.

Table 2: Probit Regression of Broadband Access in a Market

Constant	-.8394 (.2623)
Producer Surplus	.0030 (.0009)
n	69

Notes: The dependent variable is the {0,1} of whether broadband is available in the market as measured by PC World (1999). The producer surplus comes from the estimates in table 1.

Table 3: Geographic Distribution of New Adopters by Subsidy Regime
(Percent of total)

STATE	Usage Subsidy	Investment (Fixed-Cost) Subsidy
Arizona		
California	5.2	
Colorado	27.7	
Florida	4.9	
Georgia	4.3	
Maryland	4.0	
Massachusetts	3.4	
Minnesota	3.1	
New Jersey	3.4	
New York	7.7	
North Carolina	9.9	
Oregon		23.5
Pennsylvania		16.2
Tennessee	6.5	8.8
Texas		20.6
	11.4	25.0
States with Smaller Gains		
	Connecticut, Illinois, Missouri, New Hampshire, Washington, Wisconsin	Washington

Source: Author's computations as described in the text.

Table 5: Characteristics of New Adopters by Subsidy Regime
(percent of total)

Demographic Characteristic	Usage Subsidy	Investment Subsidy
AGE		
< 30	22	28
30-40	29	30
40-50	27	29
50+	22	13
HOME OWNERSHIP		
Own	64	56
Rent/Lease/Other	36	44
FAMILY INCOME		
< $50,000/year	41	40
$50-100,000	40	30
> $100,000	19	30
EDUCATION		
H.S. or Less	15	17
At least Some College	62	60
Post-Graduate	24	23

Source: Author's computations as described in the text.

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