Burden of Network Neutrality Mandates on Rural Broadband Deployment

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Abstract: Policymakers are presently evaluating policies to extend high-speed Internet services to nearly all households and business. At the same time, some communications regulators are considering regulating service providers under the auspices of network neutrality regulation. We examine empirically the impact that a regulatory mandate like network neutrality would have broadband Internet network deployment, with an eye toward the relative impacts between high-cost, rural areas and lower-cost, urban areas. Using publicly available network cost models and data from the United States, we show that under plausible conditions, while network neutrality mandates negatively impact broadband deployment in all geographic areas regardless of average cost characteristics, such rules are likely to disproportionately impact broadband deployment in high-cost areas. Moreover, our analysis that suggests the differential reduction in service availability for high-cost rural areas is six times as much as in lower cost, more urbanized markets.

I. Introduction

By all accounts, the widespread deployment of broadband services is the dominant issue in the current debate over communications regulation in almost all countries. Yet, at the same time as policymakers grapple with this difficult and complex task, there is a growing movement to impose regulations aimed to restrict the business decisions of broadband service providers in a variety of ways in the name of "network neutrality". To this end, many vocal proponents of network neutrality encourage regulators to adopt and enforce limitations on broadband pricing, service offerings, network design, network management, and consumer information (Marsden 2010). Many of these mandates would, almost by definition, make broadband networks either more costly to build by limiting freedom in network design (Clarke 2009), or less valuable by limiting efforts at surplus extraction or demand enhancement (Jamison and Hauge 2009; Sidak and Teece 2010). Increasing the cost of designing and operating broadband networks or reducing their revenue potential would certainly have a negative impact on the economics of deploying broadband. At a time when expanded broadband availability is a key policy goal, the application of regulations reducing the financial success of networks seems conflicting. Nevertheless, the debate proceeds, in part because no analysis has been performed on the impact that a network neutrality regulatory mandate would have on the incentives and ability of firms to deploy broadband services, particularly in those high-cost areas where service is often absent.

We show in this paper that while network neutrality regulation that increases costs or reduces profits would reduce broadband deployment generally, such regulations could disproportionately impact broadband in areas that are, on average, high-cost areas (such as rural markets). Empirical analysis suggests the differential between rural and urban is six fold.

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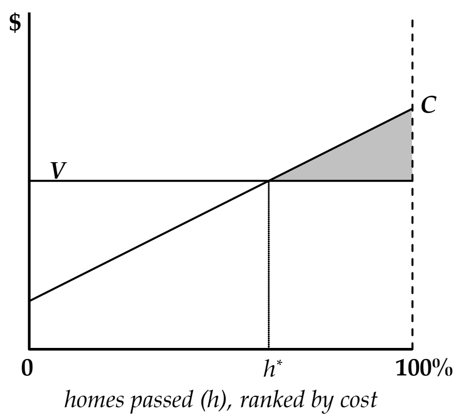
In Section II, we present a conceptual framework for this analysis, and Section III attempts to calculate the disproportionate impact that a network neutrality mandate will have. Using publicly available network cost models and data from the United States, we show that under plausible conditions, while cost-increasing or revenue-reducing network neutrality mandates will materially impact broadband deployment in all geographic areas, such rules can be expected to disproportionately impact broadband deployment in high-cost areas and potentially by a significant amount. Our particular analysis indicates the differential impact is about six times as much as in lower cost, more urbanized areas.

II. Conceptual Framework

We set out to explore the impact that increased costs (or reduced value) of a broadband network caused by network neutrality mandates could have on the eventual deployment of such network in certain areas, particularly high-cost areas. We demonstrate in this section how an increase in costs of building or operating a network could have a disproportionate impact on deployment decisions in particular areas even if the cost change from the regulatory mandate is identical across all areas.

Figure 1. Network Deployment



We can, in general, represent the effect an increase in costs has upon broadband deployment with some simple graphics. In Figure 1, we illustrate the economics of deployment. For the figure, we assume the broadband service provider must expend a fixed costs *C* to build network to a particular household (while *C* is incremental to each house, it is a fixed capital expense in that it is spent only once and is required to provide service). The cost of building a wireline broadband network varies widely by geography and to a large extent is driven by population density (Gasmi et al, 2002). The line labeled *C* in Figure 1 demonstrates this relationship—the vertical axis measures the costs to build out to a household and the horizontal axis is the percentage of households passed, where households are ranked by the fixed cost of constructing the network to *each* house.[1] Since the homes are sorted by *C*, the *C* curve slopes upward, with the lowest cost households on the far left and the highest cost households on the far right.

The horizontal line labeled *V* is the expected value of the household to the broadband network operator. The value might be considered the net revenues (or gross profits) that a firm expects to

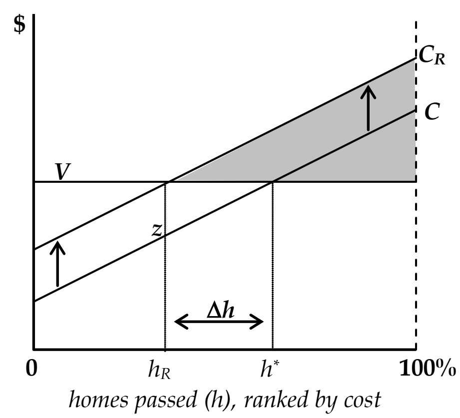
[1] In other words, the curve labeled *C* is the fixed capital cost for the household *h* and not the sum of fixed capital costs at *h*. For simplicity, we illustrate the distribution of the per-household fixed capital costs as linear across all households (with total households being *H*). We have normalized households by dividing by total households *H* so that the horizontal axis is measured on the unit interval (i.e., the lowest value is 0 and the highest value is 1 or 100%).

generate from each particular household that it passes. It is important to note that V represents the "value" of the network to the network service provider—effectively the present value of gross profits that the firm can realize from building and operating the network.[2] For our purposes, we assume that the value of a broadband network for residential consumers is essentially unrelated to the underlying capital cost of constructing network. This assumption seems reasonable, since there is little reason to think that consumers in high-cost areas are willing to pay substantially more (or less) for voice, video and high-speed broadband data services than consumers in lower cost areas. As a result, the V curve is flat.

The network firm will build a network to a household as long as the expected value meets or exceeds the fixed costs of serving household *i* (where $V \geq C_i$). This equilibrium occurs where the C and V lines intersect, rendering the equilibrium percentage of households passed of h^*. Households to the right of h^* are too costly for the private sector to serve given expected benefits V. The shaded area in Figure 1 essentially represents a type of "gap" or "shortfall"—the portion of the service area where the cost of building a network is greater than the private value of the network that can be captured as revenues by the network provider. A subsidy of this amount would be sufficient to ensure ubiquitous coverage of the network. Policymakers that seek to promote the broadest penetration level for broadband network should favor policies that seek to minimize the size of this triangle as much as possible in economically efficient ways.

Now, consider the effect of increasing the capital cost of deploying network through, say, network neutrality regulations. An increase in costs lowers the equilibrium penetration of the broadband network. Figure 2 demonstrates this effect. If regulation increases the cost of the network deployment (by ΔC, with Δ meaning "a change in"), then the C curve shifts upward to C_R (the latter being cost with "Regulation") as illustrated in Figure 2. Now, the profit maximizing network operator builds to only h_R homes, reducing deployment by Δh homes. So, Figure 2 shows how increasing the cost of network deployment through regulation reduces the equilibrium number of homes passed.

Figure 2. Network Deployment with Cost Increase from Regulatory Mandate



[2] As a result, in this conceptual framework, V only represents the net revenues from the network that the network service provider can actually collect from users of the network. It is not a statement of the complete "social" value of the network or the value that consumers would place upon the network. In analyzing a firm's build-out decision it is, of course, obvious that only the "value captured by the firm" is relevant to the firm's decisions.

For ease of presentation, in Figure 2 we treat the effect of this regulatory mandate as an increase in capital cost to deploy network. But the same effect would be observed if the regulatory mandate effectively increased the incremental (or operating) cost of or reduced the revenue that the provider could collect from the network (by shifting the *V* curve to intersect *C* at *z*).
It is important to see that not only has the cost hike decreased broadband penetration from h^* to $h_{R,}$ but the size of the shortfall shaded area has increased significantly. The "shortfall" between the cost of the network and the value of that network has increased, a development that would certainly make the goal of achieving universal access to broadband more costly to achieve.
Thus far, the conceptual argument is straightforward and intuitive, but our interest lies in the relative effect that cost increases has upon a particular category of households—those that are in high-cost areas (or areas with higher average cost of service). In particular, while our previous analysis clearly shows that a cost increase from a regulatory mandate decreases overall broadband deployment regardless of the level of cost, our focus in this paper is on whether that mandate would affect deployment disproportionately in areas that are, on average, high-cost compared to lower-cost markets.
We show now how the extent to which an increase in costs may differentially affect deployment across different areas. To do so, we turn to some simple algebra in order to demonstrate that it is not the average cost across markets that matters, but rather the slope of the cost distribution.
Looking back to Figure 1, say that all customers have the same value to the broadband service provider *V*. The capital cost to serve a household is unique and when homes are ranked from lowest to highest costs, costs are distributed linearly across homes so that

$$C = a + bh \qquad (1)$$

where *a* and *b* are parameters of the capital cost function (or distribution). The marginal (or last) home passed satisfies the condition

$$V = a + bh\,, \qquad (2)$$

meaning the firm just breaks even on the last home passed. We define this last home as h^*, which is the equilibrium number of homes passed. Rearranging Equation (2), we have

$$h^* = \frac{V - a}{b}\,. \qquad (3)$$

Consider an increase in cost on network deployment as we did in Figure 1. If network neutrality regulation increases the cost of deployment, or shifts the cost distribution upward, then we have

$$\frac{\Delta h^*}{\Delta a} = -\frac{1}{b} < 0\,. \qquad (4)$$

From Equation (4), we see the change in homes passed is related to the slope of the cost distribution. The smaller is *b,* the larger the effect on homes passed. A small *b* implies a flat cost distribution so that deployment costs are similar across homes (around h^*).

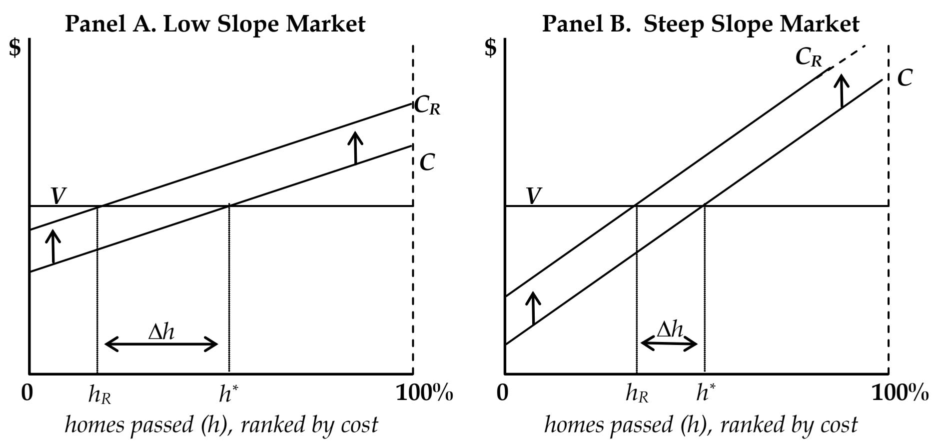
If network neutrality regulation reduces the value of the network by raising incremental costs or reducing demand or revenues, the change in homes passed is measured as

$$\frac{\Delta h^*}{\Delta V} = \frac{1}{b} > 0 \,, \qquad (5)$$

where again the change in homes passed depends only on the (inverse of the) slope of the cost distribution (*b*). Regardless of how network neutrality regulations impact profits, it is the slope of the cost distribution (around *h**, which is constant in the linear case) that determines the impact on homes passed. Further, the algebra shows that for every cost change, there is a change in gross profit that renders the same effect on homes passed.

Figure 3 illustrates the algebra by showing an increase in fixed cost in two different markets that are alike in many ways (average cost and penetration), but differ in the slopes of their *C* curves (i.e., the cost distribution). To illustrate the cost increase, the *C* curves in Figure 4 have been increased to C_R. As we illustrated in Figure 2, this increase in cost will decrease deployment in both markets, but Figure 3 shows that the market in Panel A sees a much more substantial decrease in network construction in response to an identical change in costs across markets.

Figure 3. Impact of Cost Change



This analysis reveals that a fixed increase in costs, which applies to all households equally, can affect deployment in areas differently (but always reduces deployment). The reason for this differential impact is the slope of the cost curve (*C)* in each particular market at the point where *V* intersects that curve (for these linear curves, the slope is constant). As Figure 3 reveals, if the *C* curve is relatively flat at the intersection with *V* (a small slope), then even a tiny change in fixed costs will have a substantial impact on homes passed. Alternately, if the curve is steep at *V* (the slope is large), then the percentage of homes passed is not as sensitive to changes in costs. As shown in this example, the relative deployment response is not a function of average cost or initial penetration (which are assumed identical in the figures), but is driven solely by the slope of the *C* curve. Thus, if we know the slope of the curve at and around some point, then we can make estimates of the relative responses of network deployment to changes in costs across a variety of markets.

This linkage between response and the slope of *C* suggests a very useful tool of empirical analysis. If we can calculate these slopes for particular markets, then we can make certain predictions about the extent to which a regulatory policy might disproportionately impact deployment in that particular market and compare that impact on other markets with different characteristics. It is possible, for example, to analyze whether a regulatory mandate might disproportionately affect deployment in certain areas, such as high-cost areas, or urban areas, or states, or even by the service area of a particular local telephone company.

To develop this tool, however, we need granular, cost data that allows us to calculate the slopes of these cost curves. Complicating this analysis is the fact that, unlike our figures, the actual network cost curves in markets are highly non-linear; as a result, the slope in unique at each point along the curve. Fortunately, publicly-available network cost models have been created that do in fact estimate the fixed costs of building networks in various markets throughout the country. In Section III, we demonstrate how we can use this data to analyze and effectively calculate the slopes of these cost curves around some point *V*. With this data, we also calculate an index of the relative burden between low-cost and high-cost markets. While all increases in costs should be expected to reduce deployment, this analysis will show whether the burden of an increase cost would fall on high-cost areas well beyond what an equal impact on markets would render.

III. Simulation Data and Methodology

In recent years, for the purpose of distributing subsidies and setting unbundled element rates, the Federal Communications Commission and industry have developed and utilized cost models that effectively estimate the costs of building a communications network in the United States (Gasmi, et al. 2002). For some models, cost estimates provided all the way down to the "Census Block Group" level, which are relatively small geographic areas established by the United States Census. In 1990, there were about 230,000 Census Block Groups ("CBG") in the United States, so the network cost analysis is fairly granular. We can utilize this data and these models to estimate the slope of the fixed cost curves (*C)* that we describe in Section II above. With this information, we can determine whether or not, on average, areas with higher average costs are disproportionately and negatively affected by network neutrality rules (or any other regulatory mandate).

A. *Data*

To conduct the empirical analysis, we first collected the CBG loop cost estimates (*L*) for a large number of local exchange carriers using the HAI cost model.[3] Our sample was constructed by choosing states randomly and including all carriers in the state with data available. The result of this procedure is significant diversity in geography and costs. In our sample, there are about 95 million access lines and about half of all CBGs are represented.[4]

Once the data is collected, we calculate a cost index (*u*) for each CBG by dividing the CBG loop cost by the sample mean loop cost. The distribution of *u* is an index that measures the *C* values illustrated in Figures 1 and 2, though in reality the distribution of costs is nonlinear rather than linear as illustrated in those figures. We then use the average of this index for each carrier in each state as a measure of relative costs across markets. For each market, we have an average cost index of $\bar{u}$. In summarizing our results, we will use this cost index ($\bar{u}$) as the descriptor of each carrier/market. If the cost index $\bar{u}$ is large, then the market is considered a "high cost" market, on average. If $\bar{u}$ is low,

3 HAI Cost Model Version 5.0, which was the last version of this model to provide nationwide estimates of costs. We use the HAI model because it provides cost estimates down to the CBG level, whereas the FCC's Synthesis Model results are provided at the Wire Center level only. The two models produce highly comparable estimates of relative loop costs, with the two series having a very high correlation coefficient (Ford 2004). States included in the analysis are: AZ, CA, CO, FL, NY, GA, IA, LA, MD, MO, MS, MT, NC, NE, OH, SC, TX, VA, and WV.

4 In the 1990 Census, there were 229,466 Census Block Groups defined. Our sample includes 112,990 Census Block Groups.

then the market is a relatively "low cost" market, on average. The mean of $\bar{u}$ is 1.00 and the $\bar{u}$ series has a range of 0.46 to 2.10, so we have in our sample a wide range of average costs.

B. *Results*

As we discuss in Section II above, to assess the impact of Network Neutrality regulations on different markets, our task is to measure and compare the deployment response to a particular cost change (what is Δh in response to ΔC?). To make this calculation, we must first compute h_U, which is equilibrium number of homes passed in the Unregulated environment in each market that we study. To make this calculation, we need to assume some value (V) for the network, and V must be on the same scale as our cost index $\bar{u}$ (with the mean of $\bar{u}$ being 1.00).

We initially set V equal to 1.6 and do so because it is this value that produces an average homes passed rate of 50% (with a homes passed penetration rate ranging from a minimum of 26% to a maximum of 62%).[5] Clearly, an average penetration of 50% (and maximum of 62%) is low when discussing broadband network deployment (FCC 2010: 43), but setting V equal to 1.6 allows us to establish a *lower* bound response differential to cost changes. As shown in sensitivity analysis, larger values of V only strengthen the relationship found at $V = 1.6$. Nothing prohibits considering values of V less then 1.6, except as V gets smaller the ratio of value to costs gets so small that the network is barely deployed even in an unregulated market.

After computing h_U for the 51 markets in our sample using these inputs, we then compute homes passed in the regulated environment (h_R) by raising the capital cost of deployment in all markets by the same small, fixed amount (ΔC) as we did in the conceptual analysis in the previous section. So that ΔC is constant across markets, we set ΔC equal to 5% of V (since V is equal across and constant in all markets) and then compute h_R. (This calculation again illustrates that changes in C can be equivalent to changes in V).

With both h_U and h_R computed, we can then determine whether or not there is any relationship between the change in household penetration (Δh, or the difference between h_U and h_R) and the average cost index ($\bar{u}$). Essentially, this comparison will determine whether high-cost (often rural) markets are more or less affected by network neutrality regulations than their low-cost counterparts. We define $\Delta h = h_U - h_R$, which is always a non-negative number (h_U will equal or exceed h_R in all circumstances).[6] Higher values of Δh imply larger percentage-point reductions in the homes passed rate in a given market.

We use three different tools of statistical analysis to examine the relationship between this change in penetration (Δh) and the index of average costs ($\bar{u}$). First, Figure 4 provides the scatter plot and linear fit of the relationship between Δh and $\bar{u}$. As shown above, the plotted points are measures of the inverse slopes of the cost distributions. The figure illustrates that it is typically the case that the higher are average costs in a market ($\bar{u}$), the larger is the reduction in network deployment (that is, the smaller is h). Thus, there is reason to believe that network neutrality regulations will disproportionately harm high-cost, rural areas.

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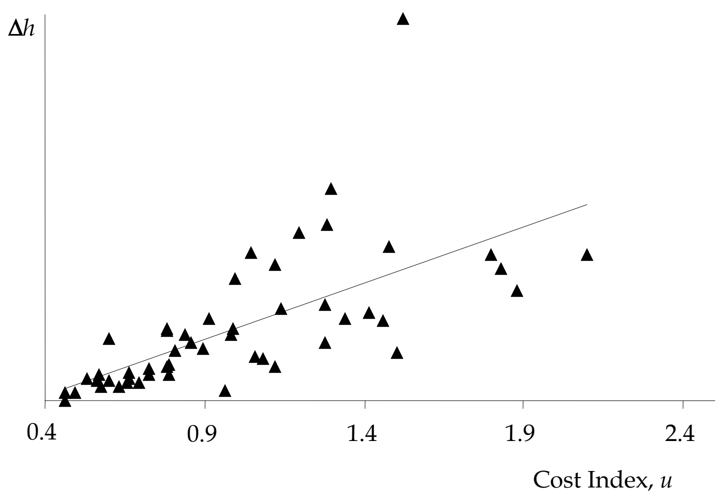
5 This assumption implies that a network company would have gross margin of about $1.60 for $100 in network investment. Press stories indicate that AT&T is spending about $250 per line to upgrade to IPTV. At $V = 1.6$, this assumes that the additional margin from the upgrade will be only $4 per month, which is probably lower than that expected by AT&T. Thus, setting V = 1.6 is conservative.

6 The calculation Δh could be zero, however, if the change leads to no reduction in homes passed because $V > u$ for all households with or without regulation.

Figure 4. Network Neutrality and Service Reduction



A second way to analyze this relationship is to compute the simple correlation coefficient between Δh and $\bar{u}$ (Gujarati 1995: 78). The computed correlation coefficient between the two series Δh and $\bar{u}$ is 0.66, which indicates a strong positive linear correlation. The correlation coefficient thus indicates that there is a high linear correlation between the reduction in network deployment and average costs of network, and confirms that network deployment is typically (though not always) reduced more in high-cost, rural areas.

Our findings of a strong relationship between Δh and $\bar{u}$ are again confirmed by using least squares regression (Gujarati 1995). The trend line in Figure 5 is based on least squares regression

$$\Delta h = \beta_0 + \beta_1 \bar{u} + \varepsilon, \qquad (6)$$

where the β are estimated parameters and ε is the disturbance term. As shown in Figure 5, the slope of the line estimated for this data is positive ($\beta_1 > 0$), indicating disproportionate harm in high-cost, rural areas from Network Neutrality regulations. The slope coefficient is statistically different from zero at better than the 1% level (t-stat = 6.12).

C. *The "Relative Burden" Index*

Our results establish that there is a strong relationship between the change in network penetration caused by a regulatory mandate and the average network cost index of a market. In other words, we can say that a regulatory mandate that increases the costs of building a broadband network will disproportionately and adversely affect broadband deployment in high-cost areas. It should not be a surprise to policymakers that an increase in network costs will decrease network deployment; what might be a surprise is the extent to which these increases costs will disproportionately affect high-cost areas, even if the costs of complying with the regulatory mandate do not vary by geography. Finding that high-cost areas will be disproportionately affected is important enough in itself, but "by how much" is an inevitable follow-up question to this conclusion. It is possible to provide a rough estimate the extent of this disproportionate impact on rural, high-cost areas. Our estimate of disproportionate impact, which we call the "relative burden index," is intuitive from a policy perspective. The availability of broadband service in all areas of the country is a national policy goal, so it would be reasonable to assume that policymakers would want their policies to apply with equal impact across markets. That is, if policymakers choose to impose a regulatory mandate that results in lower broadband penetration, then rural markets should not be burdened with more than their "fair share" of that burden. Stated differently, the probability that a household does not have access to a modern broadband network due to network neutrality regulations should be equal in high- and low-cost areas.[7] By comparing these probabilities across markets, we can generate a meaningful measure of disparity.

The results we calculate above can be used to compute this "relative burden index." To compute this relative burden index, we first compute the share of total homes in the sample for (particular definitions of) low-cost markets ($\bar{u} \leq 0.75$) and high-cost markets ($\bar{u} \geq 1.25$), which are labeled N_{HC} and N_{LC} (where subscripts "*HC*" and "*LC*" indicate high cost or low cost). Then, we compute the share of total homes passed lost to regulation for the high-cost and low-cost markets, which we label L_{HC} and L_{LC}. The index of relative burden is

$$BURDEN = \frac{L_{HC} / N_{HC}}{L_{LC} / N_{LC}}. \qquad (7)$$

The index *BURDEN* has an intuitive interpretation. If *BURDEN* = 4.0, for example, then high-cost markets bear four-times the burden from network neutrality regulations as do low-cost markets in terms of the reduction in homes passed. Put another way, if the index is 4.0, then a home in a high-cost market is four-times more likely not to have access to the network than if the home was in a low-cost market based on the imposition of network neutrality mandates. An index of 4.0 would be found, for example, if the percentage of total homes in high-cost markets is 10% and in low-cost markets is 40%, yet the high-cost and low-cost markets each contain 20% of the homes not passed due to network neutrality regulations [= (0.2/0.1)/(0.2/0.4)]. Thus, high-cost markets have 20% of the homes lost to regulation but only 10% of the homes, whereas the low-cost markets have only 20% of the homes lost to regulation but 40% of total homes. The impact in high-cost markets is, then, four times larger than low-cost markets.

Our calculations above permit us to calculate *BURDEN* for the network neutrality mandate as follows:

$$BURDEN = \frac{L_{HC} / N_{HC}}{L_{LC} / N_{LC}} = \frac{0.227/0.068}{0.382/0.722} = 6.31 .$$

Thus, network neutrality regulation burdens high-cost markets more than low-cost markets by a factor of 6.31. Moreover, *BURDEN* rises if we use more extreme definitions of "low" and "high" cost. If we define high-cost markets as those with $\bar{u} \geq 1.5$ (markets with average cost more than 50% of the mean) and reduce the low-cost market boundary to $\bar{u} \leq 0.50$ (markets with average cost only 50% of the mean), then *BURDEN* = 16.93. *BURDEN* is consistently above 1.00 for any sensible definition of low- and high-cost. Even if we define low- and high-cost as being below or above the mean cost, then *BURDEN* = 4.47.

7 This statement is true regardless of the initial level of homes passed, since the percentage change in homes passed is computed using total homes.

The disparate burden that a network neutrality mandate would impose on high-cost markets is substantial. Even though the costs of complying with a regulatory mandate may not vary by geography, broadband deployment in high-cost areas will be disproportionately affected by that mandate. The disparate burden increases significantly in even high-cost markets.

D. *Sensitivity Analysis*

We have made a number of assumptions in our analysis, but our findings are robust to alternative assumptions.[8] One area where a sensitivity analysis is particularly warranted is the estimated value of a household in terms of gross profits, which form the basis for the *V* curve. In Table 1, we present five different values of *V* (including 1.6) to evaluate the role the selection of *V* plays in our findings. As revealed in the table, the disproportionate harm to high-cost areas rises as *V* rises.[9]

Table 1. Sensitivity Analysis

V	Correlation Coefficient	t-stat(β_1)	Relative Burden (*BURDEN*)
1.6	0.66	6.12*	6.31
1.8	0.68	6.41*	6.08
2.0	0.68	6.42*	7.66
2.2	0.83	10.28*	8.93
2.4	0.82	10.06*	9.37

* Statistically different from zero at the 5% level or better.

One interpretation of the rising burden in *V* is that the more valuable the service (or, the higher the penetration in an unregulated environment), the greater will be the relative harm to high-cost markets for some given cost change. Since broadband is considered to a high-value service (indeed, the triple play is a $100+ bundle of services), our analysis suggests that the impact on high-cost areas from network neutrality regulations could be substantial.

E. *Caveats*

As with any theoretical or empirical analysis, the conclusions reported here are based in large part on the underlying assumptions of the model. We have assumed that the cost of deploying a modern broadband network is correlated with the forward-looking cost of deploying telephone network. We believe this assumption is reasonable, particularly in the case of fiber deployment. It is certainly possible to imagine networks (particularly hypothetical networks) which do not exhibit the expected cost properties with respect to household density, and in such cases our findings may change. Nevertheless, under the plausible framework we have set forth here, the results are robust.

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8 As long as the actual *C* curve for deployment is proportional to our variable *u*, the disproportionate impact on rural areas remains, though its size may differ.

9 Of course, as *V* gets smaller than 1.6, the relatively harm declines. When *V* is 0.8, the effect across markets is roughly equal (and inverted for values below 0.8). However, at $V = 0.8$, the average penetration of the service is only 34%, and as low as 12% in high-cost areas. It is little surprise that the deployment effect becomes small in high-cost areas when deployment is almost non-existent even in the unregulated state. As a technical matter, the relationship of *V* to Δh suggests that low-cost markets typically have very flat *C* curves in the lower cost segments of their markets with sharply rising C curves as penetration approaches 100%. In contrast, the C curves of high-cost markets typically rise even in the lower cost areas but do not rise very steeply as penetration approaches 100%.

IV. Conclusion

Increasing the costs of building or operating a broadband network by a regulatory mandate unquestionably will result in lower broadband network construction across the board. But our analysis shows that this decline in construction will not be evenly spread across the country as a whole—in fact, deployment in high-cost areas will be harmed disproportionately by any such cost-increasing mandate.

Using publicly available data and cost models, we show in this POLICY PAPER that a regulatory mandate like network neutrality could result in at least a six-fold relative reduction in broadband deployment in high-cost rural areas than in low-cost urban areas (under plausible conditions). In a very real way, the burden that a network neutrality mandate would create would be disproportionately (but not exclusively) borne on the back of rural America. These findings give credence to arguments raised by some that have warned that network neutrality mandates could "seriously delay the benefits of new broadband deployment" in rural communities.[10]

Understanding the impact that public policy will have on broadband deployment is of crucial importance. The goal of universal broadband service has been called the "primary challenge" of the nation's telecommunications policy. Given that overarching goal, it is therefore appropriate to examine closely a public policy like network neutrality that will disproportionately and adversely affect broadband deployment in rural areas before we rush to pass legislation. We encourage further research on this important topic.

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10 National Grange, *Rural Public Interest Group Concerned About Net Neutrality Debate in Light of Congressional Hearing*, (May 25, 2006) (available at: http://www.nationalgrange.org/PressRoom/pr/2006/Neutrality.htm).

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