



Golden LEAF Rural Broadband Initiative Evaluation

2012 Annual Report

Prepared by the UNC School of Government's Center for Public Technology

EXECUTIVE SUMMARY

The purpose of the Golden LEAF Rural Broadband Initiative evaluation is to examine the impact and added value of broadband connectivity on North Carolina communities, businesses, and citizens. Special attention is paid in this evaluation the impacts and advancements facilitated by the capital investment made by Golden LEAF. The identification and assessment of the changes stimulated by broadband connectivity will provide evidence about whether broadband is a worthwhile investment.

This annual report is our Year 2 Report, and serves as a follow-up to last year's baseline report. It will demonstrate the changes made in the last twelve months. As with the 2011 report, this evaluation seeks to map the infrastructure investments made in broadband connectivity with critical outputs and outcomes in the areas of market, economic, education, and societal impact.

KEY FINDINGS

The data collected for this Golden LEAF Rural Broadband Initiative annual report show several interesting trends. First, data collected show that median household income and rates of broadband adoption are positively correlated, meaning that as household income increases, so do the rates of broadband availability and adoption. This is not surprising, but is nevertheless important to establish at this stage in a study.

Second, the data indicate that counties that have increased their rate of broadband adoption have experienced a corresponding increase in many quality of life indicators, such as unemployment and crime rates. Likewise, counties that experienced a decrease in their rate of broadband adoption have experienced a decrease in many quality of life indicators. This indicates that broadband access and adoption lead to a better quality of life within North Carolina counties. This trend will be important to follow in future years.

Finally, broadband provider pricing has remained relatively static, or has decreased in the last year. Providers continue to offer more bandwidth options at the same prices, giving consumers more choices when selecting the broadband that they need.

SECTION 1. PROJECT OVERVIEW REVIEW



Access to high-speed, broadband Internet has become one of the great economic dividing lines in the 21st century. It is now viewed as a fundamental part of any plan to improve a community's overall quality of life including education and economic opportunities. The National Broadband Plan refers to broadband Internet access as essential infrastructure in the 21st century and is “transforming the landscape of America more rapidly and more pervasively than early infrastructure networks” (pg. 3). Furthermore, skills that can only be developed as a result of access to high-speed, broadband Internet—such as search engine use and knowledge of multiple browsers—are now absolute requirements for job seekers across the country.

The purpose of the Golden LEAF Rural Broadband Initiative evaluation remains as it was in 2011: “to examine the impact and added value of broadband connectivity on North Carolina communities, businesses, and citizens, particularly as facilitated by the capital investment made by Golden LEAF.” This 2012 annual

report serves as an update to the 2011 baseline Golden LEAF RBI report and provides information on relationships identified in the 2011 report.

Research Design and Methodology Review

For a more detailed explanation of the research design and methodology, please refer to the 2011 Golden LEAF Rural Broadband Initiative Annual Evaluation Report. The 2011 report outlines the basic design and methodology used in the project. For the 2012 report, updated data were collected for all 100 counties in North Carolina in order to provide comparative analysis on a monthly, quarterly, or annual basis, as determined by data source update frequency.

MCNC Middle Mile Proactively Plowing the Ground for Last Mile Opportunities

Although the MCNC Middle Mile fiber passing through Rockingham County is not scheduled to be lit until April 2013, tangible opportunities are already emerging to address the last mile challenges that leaves 931 households (2.4%) in the county unserved. Mark Wells, Executive Director of the Rockingham County Business and Technology Center points to valuable introductions made by MCNC between his office and a wireless mesh company that is interested in serving many of the county's remaining broadband holes. Promising discussions are underway regarding a public-private partnership that would allow the provider to leverage public tower resources to deliver the needed last mile services. Wells states that he is "really pleased that the MCNC Middle Mile Project is having this positive impact before it is even active." He noted that the MCNC fiber is likely to be seen as a cost-effective middle mile link for small and start-up providers interested serving broadband challenges communities across the state.

SECTION 2. MARKET IMPACT ANALYSIS

Almost all aspects of telephony, television, video, audio, and other communication technologies are converging into single source platforms. Access to this convergence is beyond entertainment value; it is the way in which work is done, and wealth is created.

This newly converged medium requires robust, secure broadband infrastructure which is accessible and affordable to all.

North Carolina is in the midst of attempting to improve its broadband connectivity and adoption rates as a means to achieve economic, education, and societal equity through the Golden LEAF Rural Broadband Initiative. As part of this evaluation, we have tracked the level of market penetration, competition, and costs to subscribers. This section focuses on those areas using the following metrics:

- Broadband adoption rates by county (as reported to the FCC in aggregate form)
- Baseline rates of providers in each county (updated semi-annually)
- Baseline number of providers per county (as reported to the FCC)

Together, these metrics will be used to test hypotheses related to competition, provider pricing, and broadband adoption across North Carolina counties. This evaluation will test the hypotheses using descriptive statistics, correlation, and time-series analysis.

Our data show that median household income and rates of broadband adoption are positively correlated, meaning that as household income increases, so do the rates of broadband availability and adoption.

Research Questions

In designing the evaluation plan for the Golden LEAF Rural Broadband Initiative, two primary research questions related to market impact were established:

1. Does the provision of low-cost middle-mile connectivity lower the barrier of entry for new last-mile providers in many rural communities, thereby increasing the number of providers in a given North Carolina county? There is a substantial body of existing research indicating that an increase in the number of providers has a positive impact on the rate of broadband adoption in a given community.
2. The second question evaluated was: Does the provision of low-cost middle-mile connectivity across North Carolina lead to lower costs for broadband customers, either as a function of wholesale transit costs or increased competition for the last-mile providers? Prevailing economic theories such as supply and demand would indicate that prices for services would decrease as competition increases, but in practice, it is uncommon to see a provider (or an industry) lower prices due to lower expenses without either an increase in competition or reduction in demand.

Given that we are only in the second year of this study, our sample is still not large enough to make statistically significant findings about these research

questions. However, the data collected this year when used alongside that collected in years 1, 3, and 4, will be used to fully test the questions.

Provider and Adoption Findings

As part of this assessment, we have gathered and analyzed pricing data from service providers across the state. We have also gathered and analyzed data about the rate of broadband adoption across the state on the county level from the FCC Form 477. The FCC uses a scale to represent the percentage of households connected, as follows¹:

0=Zero households connected per 1000 households

1=Greater than 0 and less than/equal to 200 households connected per 1000 households

2=Greater than 200 and less than/equal to 400 households connected per 1000 households

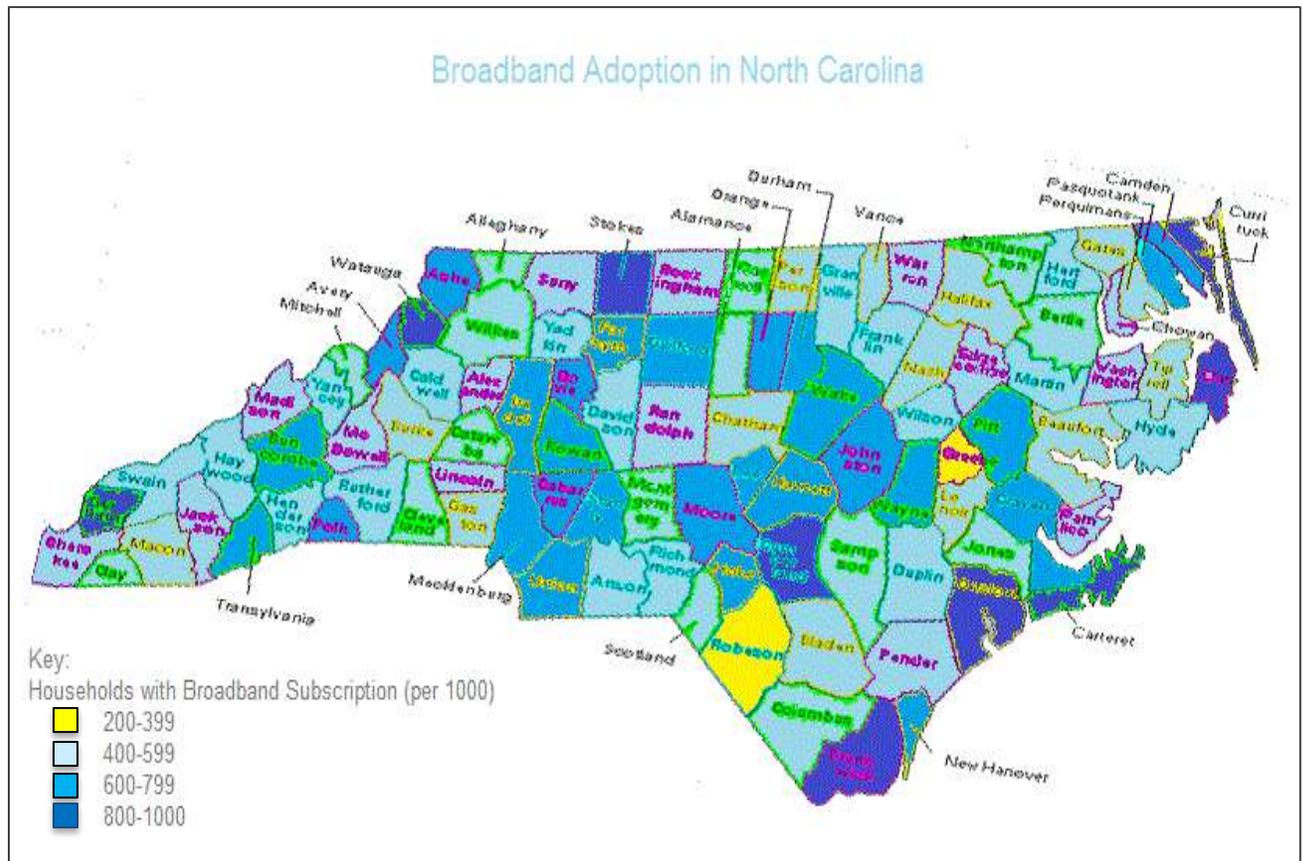
3=Greater than 400 and less than/equal to 600 households connected per 1000 households

4=Greater than 600 and less than/equal to 800 households connected per 1000 households

5=Greater than 800 households connected per 1000 households

¹ For the purposes of ease of comprehension, the report will utilize percentages for reporting this data (i.e. 20-40%, 40-60%, 60-80%, and 80+% of households connected).

The following map shows the current broadband subscribership rate by county:



This year's data indicates an overall increase in broadband subscribership in North Carolina, although it is not as drastic as last year. This is not surprising, as the rate of subscribership in most counties is over 40%. As noted in the map, two counties are still of major concern, Robeson and Greene, because of their low rate of broadband subscribership among the county population.

According to the FCC data, the following counties showed a net increase in household broadband connectivity between December 2010 and June 2011:

**Counties with Positive Household Broadband
Connectivity Change
(December 2010-June 2011)**

Ashe County 2	Hertford County 1
Avery County 2	Johnston County 3
Brunswick County 3	Pitt County 2
Camden County 1	Rowan County 2
Cherokee County 1	Rutherford County 1
Columbus County 1	Stokes County 2
Craven County 2	Transylvania County 2
Duplin County 2	Tyrell County 1
Harnett County 2	

Of the 17 counties that showed a positive increase in household broadband connectivity, six are Tier One counties, among the most distressed in the state. Another nine are Tier Two counties, and only two fall into the Tier Three designation. This information is particularly encouraging, because it indicates that even those households in the most distressed areas of the state are beginning to buy in to the notion that broadband connectivity leads to greater opportunity and a better quality of life. Furthermore, these rates are in line with last year's finding,

which is encouraging, as it indicates a pattern of increased access to broadband Internet in the most distressed counties in the state.

Three counties experienced some loss in broadband connectivity over the last year: Edgecombe, Jones, and Lenoir. Edgecombe moved from 80+% connectivity rates at the time of the 2011 report to 40-60% at this time. Meanwhile, Jones and Lenoir Counties moved from 60-80% connectivity to 40-60%.

In terms of providers, there was an overall loss of ten (10) providers across the state. One of these providers served primarily Edgecombe County, which could explain some of the decrease in overall connectivity experienced within the county in the relevant period.

This year's data, when analyzed against the data used to create the 2011 report, indicate several positive trends, including the availability of faster connection speeds and mostly static pricing. In some cases, the price of broadband service has gone down in rural areas.

Data also show that decrease in the price of broadband service is tied to an increase in residential broadband adoption rates across the state. Data also show a positive relationship between median household income and residential broadband adoption rates. This means that the data suggest that, the higher a county's median household income, the higher the adoption rate, and the lower the price of service, the higher the adoption rate in a given county.

Pricing and Competition Findings

The findings regarding pricing and competition have remained steady since the 2011 annual report. In short, pricing data seems to be generally consistent across counties. Variation between providers within counties, as well as in average prices across counties, is small. As projected in last year's report, there has been another increase in bandwidth offerings in both within a given pricing tier and from specific providers. Customers are both being offered more bandwidth for the same (or lower) prices as they had been previously, and generally have more bandwidth choices. Again, this bodes well for the impact of Golden LEAF's efforts, as it indicates a trend in offering more choices and more bandwidth at the same or lower rates.

SECTION 3. ECONOMIC IMPACT ANALYSIS

According to a World Bank report “...for every 10 percentage-point increase in high-speed Internet connection, there is an increase in economic growth of 1.3 percentage points (Chikiamco, 2009).”

Similar to the 2011 annual report, the economic impact analysis presented here uses compares data collected before the Golden LEAF Rural Broadband Initiative as a baseline. The 2012 report also uses data during the Golden LEAF Rural Broadband Initiative as a point of comparison. As the project continues, this method will continue to be employed in order to make comparisons longitudinally over the duration of the project. This section focuses on the following areas:

- Gross sales
- Number of businesses (SML)
- Annual median household income
- Average annual wages
- Job creation and retention
- Industry mix (namely, the percentage of IT-intensive jobs)
- Self-employment rate
- Employment rate
- Population density
- Percentage of private sector employment

- Home ownership

Research Questions

The primary research question related to the economic impact of the Golden LEAF Rural Broadband Initiative remain the same as noted in the 2011 annual report and is: Does increased access and adoption of broadband connectivity in households lead to positive economic outcomes in North Carolina counties? To date, most research has indicated mixed results in response to this question. However, the data collected for the 2011 annual report for the Golden LEAF Rural Broadband Initiative indicated a statistically significant relationship between broadband access and connectivity and employment, contrary to previous studies.

Economic Impact Findings

Last year, the baseline data analysis indicated that broadband adoption had a positive and statistically significant impact on wealth measures, including home ownership, median household income, gross sales, and average annual wages. Although this remains true, it is also worth noting that there is also a positive relationship between a county's tier and the rate of broadband adoption. This means essentially that the wealthiest counties in the state have, on average, higher rates of broadband adoption and access than the poorest, most underprivileged counties.

Similarly to data from the baseline and 2011 study, there is a positive correlation between employment rate and broadband adoption, accounting for approximately 36% of the variation. However, when controlling for wealth

measures, population density, and industry mix, as done in the previous report, the impact of the relationship is marginal and not statistically significant. Analyzing the impact over the length of the study will allow for greater understanding of the true impact and effect of broadband on key indicators, such as employment rate.

As the local, state, and national stabilize over the next few years, it will be important to monitor this data. Currently, there is incredibly wide variance between the economic data within counties over the years collected, mostly due to the Great Recession. Because there is such wide variance and the pre-recession figures probably are not indicators of the economic future of any given North Carolina county, it is nearly impossible to tell which factors are simply correlated and which actually cause a better economic state of being within a county.

Spotlight on Teleworking: A Tool for Leveraging Local Competitiveness

Telework allows employees to work from off-site locations and to keep in touch with supervisors and coworkers and clients through the use of computers, telephones, and other communications equipment. Telecommuting is a more limited term that refers to work done from home, without any commute at all. Two examples in **Alleghany County** illustrate what is meant by these terms. An entrepreneurial firm offering medical transcription services to clients in multiple states established operations in the Blue Ridge Business Development Center precisely to take advantage of the high-speed, redundant broadband services that are available at this telework center, but not at the entrepreneur's rural residence. Down the road at Alleghany Medical Hospital, medical transcription, once an on-site function, now is served off-site and via telework, as is radiology diagnosis. In both cases the managers cite the critical need for competitive broadband services. Jobs that could go anywhere can be retained locally as long as the broadband infrastructure provides the quality of connectivity needed to support this vital service.

Telework is an increasingly important factor in business competitiveness. Objective studies done at the local, state, national and international levels have shown telework to be a business power tool that is associated with impressive increases in productivity, profitability and employee empowerment. This killer- app can be especially important for smaller and rural communities that can attract and retain high-value jobs with relatively modest investments in up-graded broadband

infrastructure. While not all jobs lend themselves to telework, it is estimated that the work done by between 40 and 50 percent of all employees could be done remotely, at least part-time, while 25 percent have the potential to be full-time telework positions. Benefits of telework are well-documented: firms with progressive telework policies experience an average 25 percent increase in productivity, annual savings of \$2,000 per employee resulting from 63 percent reduction in absenteeism, up to 30 percent savings in facilities cost, increased responsiveness, expanded access to talent pools of handicapped and retired workers and up to 85 percent increase in employee retention. When compared to traditional workers, those who telework experience greater job satisfaction, improved health, reduced stress and better time management.

Telework is green, it's inexpensive and it's good for businesses, employees and communities. A year-long telework pilot study of 150 North Carolina State Employees in 2000 documents environmental benefits that for each 1,000 workers would produce 70 tons reduction in pollution, 50 work years of reduced traffic congestion, 200,000 gallons of fuel reduction and 500,000 miles of reduced vehicle mileage. Given a state workforce in excess of 4 million, a one percentage point increase in teleworkers would save more than 8 million gallons of fuel and 20 million vehicle miles annually!

In the United States, 34 percent of workers are estimated to work from home at least one day per month and another 17 percent are full-time teleworkers. Comparison with our state data tells a familiar story of two North Carolinas. A 2011 statewide survey of more than 1,500 households and 6,000 organizations conducted

by Strategic Networks Group for NC Broadband revealed that 32.8 percent of North Carolina workers telework at least part-time, with regional breakdowns as follows: Research Triangle 40.2 percent; Charlotte 38.2 percent; Advantage West 28 percent; Piedmont Triad 26.4 percent; Southeast 21.9 percent; Northeast 20.5; and East 19.7 percent. We need to understand the reasons behind these differences.

Telework is highly relevant to economic opportunities and challenges facing the state. Call center recruitment and farm-shoring opportunities combine with extended and potentially crippling transportation projects to create a pressing need to encourage interest in telework. Telework adoption needs to be monitored and tools, policies and statutes promoting its use implemented.

SECTION 4. EDUCATIONAL IMPACT ANALYSIS

Studies have indicated that broadband connectivity in schools eventually leads to better operational stability (Crabtree and Roberts, 2003; Underwood *et al.*, 2003, 2004). While the Golden LEAF Rural Broadband Initiative will focus primarily on the impact of broadband connectivity on virtual education, it also assesses overall performance data from North Carolina schools.



Increasing connectivity in classrooms across North Carolina has been a priority over the last several years. Recent initiatives have incentivized “Internet classrooms” and 1:1 computing across the state. The Golden LEAF Rural Broadband Initiative expands on these efforts in public schools by concentrating on virtual classrooms.

The following metrics were used to assess the impact of broadband connectivity on education in North Carolina:

Student Performance

- EOG/EOC test scores
- AP enrollment
- Dropout rates
- SAT/ACT scores (and % of students taking)
- Student connectivity at home

- Discipline incidents
- Attendance

Teacher/Classroom Performance

- Technology Usage
- Advanced degrees
- NBCT
- Certified Media Coordinators
- Certified Instructional Technology Facilitators
- Students per Internet-connected device

Virtual Enrollments

- Virtual enrollment in K-12
- Virtual community college enrollments
- Virtual university/college enrollments

Research Questions

The two primary research questions remain the same from the 2011 annual report and are as follow:

1. Does an increase in high-speed Internet access (increased reliability and stability of operations) improve teacher confidence in technology, and subsequently increase technology use in the classroom?

2. Does increased high-speed Internet access lead to better educational outputs, such as test scores, in part due to improved attendance and reduced discipline incidents?

Unfortunately, educational outcomes have a notoriously long lag effect. As a result, we are only at the very beginning of our longitudinal analysis of educational outcomes. The analysis of educational outcomes in this report encompasses both the baseline data collected for the 2011 report as well as updated data collected for the more recent school years.

Educational Impact Findings

Of the six Tier One counties that experienced increased household connectivity in the relevant time period, five reported fewer incidents of violence and a higher rate of attendance in their schools during the same period. Half of these counties also reported an increase in the average student SAT score, which is particularly significant given that North Carolina's state average has gone down in the same period. Finally, all but one of these counties—among the forty most distressed in the state—reported decreased unemployment in the same period. These findings indicate significant progress for these counties, and suggest that, in the most depressed counties in the state, broadband subscribership is tied to a better quality of life.

As previously mentioned, the data also showed three counties where the rate of overall household subscribership decreased in the relevant time period (Edgecombe, Jones, and Lenoir Counties). Each of these counties experienced an

increase in total crimes during that period, and two of the three experienced lower school attendance, and decreased SAT scores.

Together, these findings indicate that, as a county increases its connectivity, access, and adoption, students perform better in school and community members experience an increased quality of life. Likewise, as connectivity, access, and adoption decrease, so too do several quality of life measures.

Portrait of Broadband Impact in Education

In Lenoir County, the North Carolina Connectivity Project has resulted in an increase in High Speed Internet Bandwidth to our LEA. This High Speed connectivity has had the following positive impacts in our district:

- An increase in the number of students who are able to simultaneously participate in online formative assessments.
- Student strengths and weaknesses can be quickly identified allowing for immediate interventions.
- Access to educational and administrative resources including Learn and Earn Online, NCWISE, LEARN NC, NCWISE Owl, and others.
- Greater global awareness via student participation in virtual field trips.
- An increase in on-line delivery of Professional Development to Teachers.
- Reimbursement of WAN connectivity costs has allowed infrastructure improvements that otherwise would not have been funded.

It is hard to imagine how the students of Lenoir County will be able to compete on a national or global level without high-speed connectivity.

SECTION 5. SOCIETAL IMPACT ANALYSIS

As discussed in the 2011 annual report, some studies have found (notably, Ruiz, 2004) that broadband access is a critical part of rural community development through the improvement of the economy, health care, and overall quality of life.

This section will discuss the transformational impact on individuals in communities as a function of the Golden LEAF Rural Broadband Initiative.

Among the variables that were included in this evaluation are:

- Mortality rate
- Voter participation
- Total number of households
- Home ownership rate
- Housing rent
- Median household income
- Crime index.

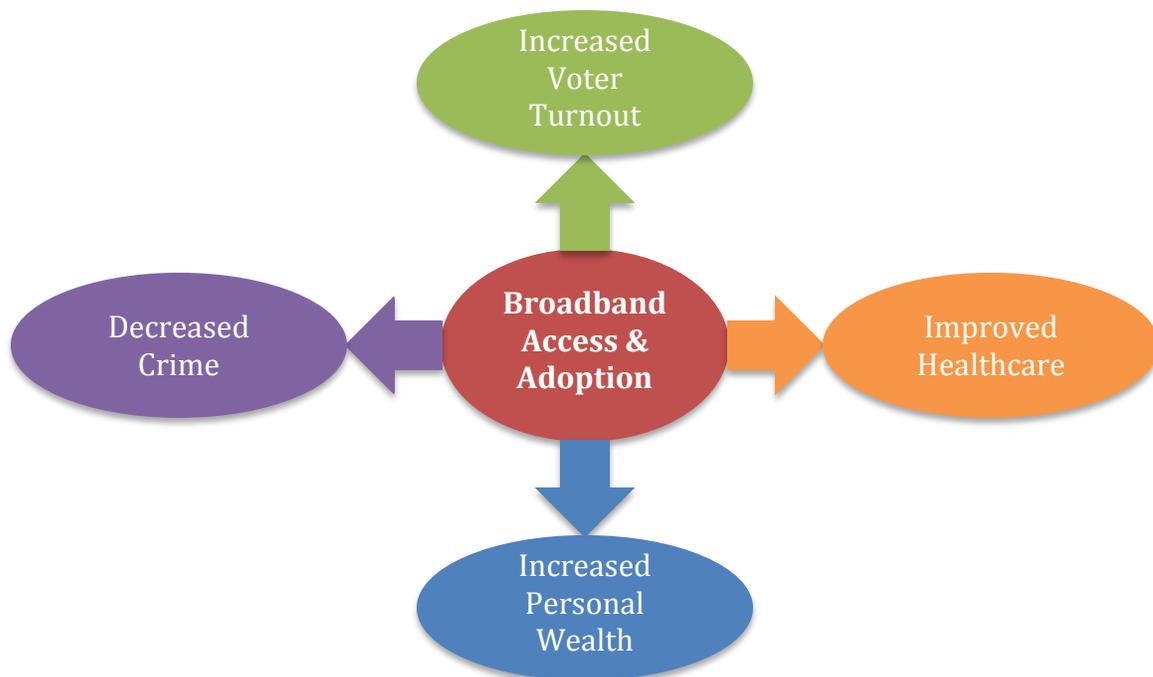


Research Question

The primary research question related to the societal impact of the Golden LEAF Rural Broadband Initiatives remains the same as last year: Does increased access and adoption of broadband connectivity in households lead to positive societal outcomes in North Carolina counties? We have defined measures of societal

outcomes to include infant mortality rates, voter participation, personal wealth measures, and crime rates. The following graphic, a variation of which appeared in the 2011 annual report, illustrates our hypothesis for affect of broadband access and adoption on societal measures:

Research Model for Societal Impact



The nature of this year's data made is somewhat difficult to discern whether broadband access and adoption had a statistically significant impact on many of these societal measures. For example, there is always increased voter participation in years with a national election, and this is even more pronounced in years with a Presidential election. 2012 saw a Presidential Election, and the 2011 elections

included both national elections and major ballot initiatives, encouraging increased voter turnout.

On a smaller, more micro level, our data do indicate that increased broadband connectivity and access lead to an overall better quality of life. These findings are included in the Educational Impact Analysis Findings section earlier in this report (both societal and educational factors were considered in the analysis).

Other than the findings discussed in detail in the Educational Impact Analysis Findings section, few statistically significant relationships were found. There is significant evidence from MCNC, e-NC, and the NC TeleHealth Network that indicates important societal impacts from broadband availability, and we expect that our data will eventually show similar impacts. Unfortunately, our sample is not year large enough and includes too many potential outlier years in order for us to say with confidence that the relationships are the same.

SECTION 6. CONCLUSION

From a policy standpoint, the results of our analyses have several important implications. During Year 1 (2011), the analysis demonstrated the “salience and criticality of the work of the Golden LEAF Rural Broadband Initiative.” As a result of the 2011 analysis, we saw evidence that the digital divide impacts access to quality educational resources outside of schools. The 2011 analysis also garnered some evidence that broadband access and adoption are positively related. If this trend continues, then it is solid evidence about the return on investment for affordable broadband availability: it would help to combat the recession and make North Carolina counties thrive.

The 2012 analysis that we conducted also has important policy implications. First, the Tier One counties that increased their rate of broadband adoption (according to the FCC) are experiencing an increased quality of life, even in measures that counties with more advantages are falling behind, such as unemployment rate and SAT scores. Likewise, counties from all tiers that experienced decreased adoption rates have experienced a decreased quality of life including an increased crime rate, increased unemployment, and lower school attendance.

Of course, the findings presented in this report represent only the first year worth of analysis since the Golden LEAF Rural Broadband Initiative was implemented in North Carolina (the 2011 annual report was a baseline report). Future analysis will give us a more complete picture of the state of broadband in

North Carolina. These analyses will also build on times-series data (such as employment growth indicators) and assist in determining the effective market, economic, educational, and societal impacts of broadband availability and adoption across North Carolina counties.

“The number one benefit of information technology is that it empowers people to do what they want to do. It lets people be creative. It lets people be productive. It lets people learn things they didn't think they could learn before, and so in a sense it is all about potential.”

Steve Ballmer, Microsoft CEO

**Contributing Faculty and Staff to the
Golden LEAF Rural Broadband Initiative Evaluation**

Amanda Shomper

Amy Huffman

Anne Davis

Deborah Watts

Karl Smith

Maureen McCormick

Maurice Ferrell

Shannon Tufts

Stacey Hypes

Will Lambe

Willow Jacobson