Measuring the Economic Impact of Broadband

NTIA Webinar Series

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September 18, 2019
Participants

Presenters

• Alison Grant, Research Assistant and Instructor, Department of Agricultural Economics, Purdue University

• Brian Whitacre, Professor, Oklahoma State University

• Roberto Gallardo, Assistant Director - Center for Regional Development, Purdue University

Moderator

• Katherine Bates, Manager of State and Local Partnerships, BroadbandUSA
Helpful Information

Questions
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• The presentation along with a transcript and an audio recording will be available on the BroadbandUSA website within 7 days of this webinar under Events/Past Events.
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The Net Benefits of Broadband Adoption: An Empirical Case Study of Rural Indiana

Alison Grant, Graduate Student, Purdue University
Wallace Tyner, James and Lois Ackerman Professor
Larry DeBoer, Professor, Agricultural Economics, Purdue University

Links to Studies:
- Benefit-Cost Analysis for Implementation of Rural Broadband in the Tipmont Cooperative in Indiana
- Estimation of the Net Benefits of Indiana Statewide Adoption of Rural Broadband
Data – Fuel for the Future

• “Digital information is unlike any previous resource; it is extracted, refined, valued, bought and sold in different ways. It changes the rules for markets and it demands new approaches from regulators.”
  “Fuel of the future: Data is giving rise to a new economy.” The Economist, May 2017

• “The economic impact of rural broadband will be more important for the role it plays in changing what the economy is. It has also disrupted the role that location plays in the economy. This disruption will reach as far as the broadband speed required to support these uses will allow.”
  Kuttner, Hanns. “The Economic Impact of Rural Broadband.” Hudson Institute, April 2016
Overview

1. Present value of total benefits and costs by category for the Tipmont Case Study

2. Other metrics
   1. Benefit cost ratio
   2. NPV benefit per member
   3. Annualized benefit per member
   4. Benefit per $1 expended by customers

3. Review the extrapolation of broadband benefits to the State of Indiana

4. Tax and govt. expenditure impact calculations
Summary of Results

• The benefit/cost ratio is around 4
• Statewide, the net benefits (NB) amount to about $1 billion/year
• Federal and state governments would have increased tax receipts and lower Medicare and Medicaid costs.
• Government tax revenues and health care cost savings amount to about ¼ of total NB
Study Approach

- We estimated rural broadband benefits by category (type of benefit)
  - Telemedicine
  - Education (K-12 & Adult)
  - Consumer savings
  - Farm income increases
  - Multiplier benefits
- System cost information came from Tipmont
Other Assumptions

- We used a 6% discount rate for future benefits and costs
- We used a 20 year project period, but clearly benefits would continue beyond that period.
- The take rate was taken from analysis done by Prof. Nicole Widmar
## Benefit Cost Summary for the Different Benefit Categories

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<tr>
<th>Item</th>
<th>Net present values</th>
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<td>Missed Work</td>
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<td>Web consultation</td>
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<td>Urgent care</td>
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<td>Emergency care</td>
<td>110,986,276</td>
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<td>Total telemedicine</td>
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<td>K-12 education</td>
<td>18,981,795</td>
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<td>Adult education</td>
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<td>Multiplier impacts</td>
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<td>106,946,014</td>
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<td>Farm income increase</td>
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<td>System revenue</td>
<td>102,123,515</td>
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<td>Total Benefit</td>
<td>749,698,635</td>
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<tr>
<td>Net benefits</td>
<td>560,280,195</td>
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</table>
Benefit Categories by Share of Total Benefits

- Telemedicine: 30%
- Multiplier impacts: 25%
- System revenue: 14%
- Adult education: 14%
- Consumer savings: 14%
- K-12 education: 2%
- Farm income increase: 1%
Tipmont Result Summary

- NPV benefit per member: $24,757
- Net benefit per member per year: $2,158
- Benefit-cost ratio: 3.96
  - Every $1 invested in broadband returns $4 to the local economy
  - Every dollar expended by customers returns $4.5
- In terms of extrapolating to the state: we use the benefit per co-op member for all other state co-ops
Telemedicine

• Overview of Benefit Categories:
  1. Hospital Cost Savings from Outsourcing Procedures
  2. Lab/Pharmacy Work Performed Locally
  3. Reduced Use of Emergency Departments, Overnight Stays, Ambulance Services, Number of Referrals, etc.
  4. Initial Health Consultation via Web
  5. Transportation Savings
  6. Missed Work Income

• $20.5 million in year 3
• $223 million NPV over 20 years
Education K-12

- Benefit Estimation included proxy of the value of improvement in teacher productivity
- We know that teachers provide value greater than their cost
- Used teacher salaries as a basis for a productivity increase
- Benefit Estimation: $1,538,383 in year 3
The Tipmont customer median household income is $73,092.

We assume that 1 in 5 of those households would have a new or better job valued at 5% of household income.

This benefit calculation is scaled to connected households each year.

- Benefit Estimation: $9,594,041 in year 3
General Economic Development

• Household income growth, business investment, and consumer savings
• Previous work had suggested a household income gain independent of other categories. However, we decided to assume it is included in the adult education and multiplier categories.
Multiplier Benefits

• When an investment is made, the spending associated with that investment provides benefits to those who receive the spending and to others in the community.

• We used two sources of multiplier values of 1.99 and 1.3264, and also 0.99 thereby excluding the system costs.

• Multiplier NPV ranged from $188 million (base case) to $376 million NPV.
Consumer Savings

• Consumers potentially save in purchases of household items, insurance, energy, services, etc.

• A UK study by Price Waterhouse Coopers estimated household savings of $754/household/year
  – Benefit Estimation: $ 9,896,989 in year 3
Farm Income Increases

• The literature indicates farm sales and expenses grow due to broadband access (encompasses access to information, technology such as GIS and scouting drones, precision ag, etc.)

• Tippecanoe County crop sales in 2012 were $132,619,000 and we assumed a 1% increase due to broadband and applied it to 50% of sales. We also used a lower bound of $500 per connected member.

  – Benefit Estimation: $663,095 in year 3
Civic Engagement

• We found two important studies on the impacts of broadband on civic engagement and voluntary activity
• The qualitative descriptions of benefits were significant
• We could not quantify this benefit
• This is a probable benefit that has been left out in our calculations
## Investment Costs

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<td>Drop Installation*</td>
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<td>Subscriber Electronics*</td>
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<td><strong>Total Build Capital Cost</strong></td>
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*Based on 100% take rate
# Operating Costs

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<th>Revenue</th>
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<th>Billing</th>
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| NPV  | 13,527,498 | 24,485,885 | 14,1839    | 102,123,515 | 1,429,729 | 145,164 | 1,106,338 | 1,134,706 | 1,021,235 | 3,164,847 | 43,598,480 | 89,613,882 |
Recap

• Total NPV over 20 years: $560 million
• NPV benefit per member: $24,757*
• Annualized benefit per member per year: $2,158
• Benefit-cost ratio: 3.96
  – Every $1 invested in broadband returns $4 to the local economy
• NPV revenue/NPV cost = 0.54

*Over a 20-year time horizon
State Extrapolation

• NPV per member for the 7 cooperatives is $24,293.

• There are 400,263 cooperative members in Indiana not included in the 7.

• The extrapolated Statewide NPV benefits are $11,976,222,899, or about $12 billion.

• Over 20 years at 6%, that translates to $1.0 billion per year.
Indiana Broadband: State Commits $100M; New Study Shows Value of High-Speed Access

Published
August 31, 2018

Author
Cathy Cash

Tags
Broadband,
Rural Economic Development

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A Purdue University study finds that broadband internet access in rural areas could mean billions in economic benefits for Indiana. (Photo By: Jenna Wagner, iStock/Getty Images)
Thanks!

Alison Grant
Research Assistant and Instructor
Department of Agricultural Economics
Purdue University

email: grant73@purdue.edu
Measuring the Economic Impact of Broadband

Brian Whitacre
Oklahoma State University

NTIA Broadband USA
Webinar Series
September 18, 2019
What the Research Says

• Broadband DOES matter for a whole host of social & economic outcomes!
  • Household income
  • Employment levels
  • Firm attraction
  • Farm profits
  • Civic engagement
  • Increased housing values

• Adoption is (arguably) more important than simple availability

• The extent to which very fast speeds matter is TBD...
Broadband and Household Income

- **Koutroumpis** (2009):
  - Broadband accounted for 10% of annual economic growth in OECD countries

- **Czernich et al.** (2011):
  - Positive relationship between broadband expansion and annual per capita growth in OECD countries

- **Whitacre, Gallardo, Strover** (2014a):
  - Rural areas with high broadband adoption had faster Median Household Income growth between 2001 - 2010
Broadband and Employment Levels

- **Atasoy** (2013)
  - Access to broadband is associated with a 2% increase in employment rate

- **Jayakar and Park** (2013)
  - Counties with better broadband availability had lower unemployment rates

- **Whitacre, Gallardo, Strover** (2014b)
  - Rural counties with high broadband adoption had more firms / employees

- **Kolko** (2012):
  - Positive relationship between broadband expansion and local employment growth
Broadband and Firm Attraction

• **Mack and Rey** (2014)
  - Highlights importance of broadband to U.S. knowledge-based firms

• **Kim and Orazem** (2017)
  - Broadband availability had positive effect on location decisions of rural firms in early 2000s.

• Deller, Whitacre, Conroy (working)
  - BB speed availability has impacts on rural entrepreneurship levels
Broadband and Farm Profits

• Kandilov, Kandilov, Liu, Renkow (2017)
  • Broadband loan program has positive impacts on farm sales, expenditures, and profits

• Jeffcoat, Davis, Hu (2012)
  • Farmers without broadband access willing to pay more in property taxes to support broadband investments
Broadband and Civic Engagement

- **Mossberger, Tolbert, Hamilton** (2012)
  - Broadband crucial for gathering civic information

- **Broadbent and Papadopoulos** (2013)
  - Communicating with friends / family significant benefit for disadvantaged residents

- **Whitacre and Manlove** (2016)
  - Levels of broadband adoption matter more than simple availability for predicting how civically engaged rural residents are
Broadband and Housing Values

- **Molnar, Savage, and Sicker** (2015)
  - Fiber availability increases U.S. urban housing values by 3%

- **Ahlfeldt, Koutroumpis, Valletti** (2014)
  - Upgrading to 8 Mbps connection in England increased property values by 3%

- **Deller and Whitacre** (2019)
  - Rural housing values positively impacted by higher-speed access... but “some” matters more than “very fast”
Broadband Policy

- Federal efforts to increase availability have worked...
  - Dinterman and Renkow (2017)
  - ASR Analytics (2014) – ARRA Evaluation

- But increasing adoption is much harder!
  - Hauge and Prieger (2015)
  - Manlove and Whitacre (2019)
Does Speed Matter?

Mixed Evidence to Date

• **Positive Results:**
  
  • *Briglauer et al.* (2019) show that German county-level GDP grew 0.05% for each 1% increase in 50 Mbps availability.

  
  • *Lobo et al.* (2019) find that ultra-fast broadband reduces county unemployment rates in TN.

  
  • *Hasbi* (2017) finds a positive impact of high-speed broadband on company creation in France.
Does Speed Matter?

Mixed Evidence to Date

- **Negative Results:**
  - **Ford** (2018) shows no difference in economic outcomes between counties with 10 MBPS and 25 MBPS. Is faster better? Quantifying the relationship between broadband speed and economic growth.
  - **Whitacre et al.** (2019) refute an earlier paper showing that faster speeds increase employment levels. Econometric error nullifies finding of the impact of broadband speed on county-level employment.

George S. Ford

Brian E. Whitacre, Md Rafayet Alam, Bento J. Lobo

Broadband adoption and firm productivity: Evidence from Irish manufacturing firms.
Thank you!

Brian Whitacre
Professor, Oklahoma State University
email: brian.whitacre@okstate.edu
Broadband’s Impact: Conveying the message

Roberto Gallardo, Ph.D.
Purdue Center for Regional Development / Extension

@robertoge
#Rural2pt0

PURDUE UNIVERSITY
Center for Regional Development | Extension
Digital age makes possible

- Commerce
- Banking/Funding
- Education & Employment
- Entertainment
- Communication
- Email
- Information
- Productivity
- Healthcare
- Innovation/Collaboration

Credit: Jordana Barton. Federal Reserve Bank of Dallas
2017 Digital Economy in the U.S.

5.1 million jobs

$132,223 average compensation

6.9% of GDP

$1.35 trillion

Source: Bureau of Economic Analysis
Unlocking Rural’s Digital Potential

• $47 billion per year to the U.S. GDP
• 360,000 jobs in the next 3 years

Source: C_Tec; Amazon
Potential of Precision Agriculture

Broadband infrastructure
Digital technologies
On-farm capabilities

Row crops
Specialty crops
Livestock & dairy

Planning
Production
Market coordination

$47-$65B/year
$18-$23B

Source: USDA
Digital Globalization

1. 19 years old

2. Larger impact on GDP than 100s year old goods trade

3. Includes developing countries, small companies, start-ups, & billions of individuals

Source: McKinsey Global Institute
Airbnb
4 years
600,000 rooms
Hilton
93 years

Total Rooms

Marriott
742,635
Hilton
724,943
Starwood
313,800
Airbnb
1,000,000+

Source: World Economic Forum
100,000 Kickstarter funded projects

169 countries

86,101 creators

9 million backers

2,317 miles

Source: Kickstarter
Decreasing local banks in rural …

Source: Wall Street Journal
What is Digital Inclusion?

Refers to the adoption of broadband technologies and its meaningful use for social and economic benefits.

Source: Community Developments Investments Magazine, November 2018
Digital Inclusion Dimensions

1. Affordable & robust broadband
2. Internet-enabled devices that meet needs of user
3. Digital Literacy training
4. Quality technical support
5. Applications & online content that encourage self-sufficiency, participation, & collaboration

Source: National Digital Inclusion Alliance
Jobs Vs. Productivity

Source: Brookings Institution

Manufacturing sector inflation-adjusted output and employment, 1980 to 2015

Source: Brookings' analysis of Moody's Analytics estimates
Future of Work

512 Counties (83.7 percent rural)

20.3 million people

25% displaced workers in ten years

No sudden robot takeover, but an ongoing and accelerated change in how work is organized

Source: McKinsey & Company
Workforce Development

Up to 54 million workers in the US or one-third of workers in 2030 may need to switch occupational categories

Middle & Digital Skills

Occupations that typically don’t require a bachelor’s degree and pay above the national living wage.

Source: Capital One; Burning Glass

As Technology Transforms the Workplace, Digital Skills are Critical to Future Proof Middle-Skill Careers

46% of labor demand is composed of MIDDLE-SKILL jobs

82% of middle-skill jobs require digital skills, an increase of 4% since 2015
Google, Apple and 12 other companies that no longer require employees to have a college degree

Published Mon, Oct 8 2018 • 12:51 PM EDT • Updated Mon, Oct 8 2018 • 12:51 PM EDT

Courtney Connley
@CLASSICALYCOURT

Source: Glassdoor
It is not only coding ... “Behavioral skills, such as the ability to work well on a team, communication, creativity, and empathy are best developed through experience rather than structured learning programs like a webinar.”

<table>
<thead>
<tr>
<th>Skill</th>
<th>2016</th>
<th>2018</th>
<th>Change</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Willingness to be flexible, agile, and adaptable to change</td>
<td>4</td>
<td>1</td>
<td>3 ▲</td>
<td>Soft</td>
</tr>
<tr>
<td>Time management skill and ability to prioritize</td>
<td>7</td>
<td>2</td>
<td>5 ▲</td>
<td>Soft</td>
</tr>
<tr>
<td>Ability to work effectively in team environments</td>
<td>5</td>
<td>3</td>
<td>2 ▲</td>
<td>Soft</td>
</tr>
<tr>
<td>Ability to communicate effectively in business context</td>
<td>3</td>
<td>4</td>
<td>-1 ▼</td>
<td>Soft</td>
</tr>
<tr>
<td>Analytical skills and business acumen</td>
<td>0</td>
<td>5</td>
<td>3 ▲</td>
<td>Technical</td>
</tr>
<tr>
<td>Technical core capabilities for STEM</td>
<td>1</td>
<td>6</td>
<td>-5 ▼</td>
<td>Technical</td>
</tr>
<tr>
<td>Capacity for innovation and creativity</td>
<td>9</td>
<td>7</td>
<td>2 ▲</td>
<td>Soft</td>
</tr>
<tr>
<td>Basic computer and software/application skills</td>
<td>1</td>
<td>8</td>
<td>-7 ▼</td>
<td>Technical</td>
</tr>
<tr>
<td>Ethics and integrity</td>
<td>10</td>
<td>8</td>
<td>2 ▲</td>
<td>Soft</td>
</tr>
<tr>
<td>Foreign language proficiency</td>
<td>12</td>
<td>10</td>
<td>2 ▲</td>
<td>Technical</td>
</tr>
<tr>
<td>Fundamental core capabilities around reading, writing and arithmetic</td>
<td>5</td>
<td>11</td>
<td>-6 ▼</td>
<td>Technical</td>
</tr>
<tr>
<td>Industry of occupation-specific skills</td>
<td>11</td>
<td>12</td>
<td>-1 ▼</td>
<td>Technical</td>
</tr>
</tbody>
</table>

Source: Bloomberg; IBM
Homework Gap

Barriers when completing online assignments and homework due to lack of appropriate devices and/or broadband

- Lower graduation rates
- Score lower on tests

17% of U.S. students with no computer access
18% of U.S. students with no broadband access

Source: Associated Press
Telework

- 50% of US workforce hold jobs that are compatible with telework
- Teleworkers can save $4,000 per year (gas, wardrobe, lunch expenses, etc.)
- Companies can save about $2,000 per employee per year
- Can reduce turnover by 50%

Source: Flexjobs.com; GlobalWorkplaceAnalytics.com
Healthcare + Smartphone

• Most significant innovation in modern healthcare
• Mobile Health (mHealth): $23 billion; $102 billion by 2022
• Hearing implants
• Depression-combating Facebook messenger bots
• Instant ultrasounds
• Pancreatic cancer

Source: Futurism
Moving forward ...

Update required

Hang on while we fetch the update 39%
Change is not easy

“Doubt is an uncomfortable condition, but certainty is a ridiculous one.”

Voltaire
In summary ... 

- Quality of life
- Homework gap
- Sustainable community & economic development
- Workforce development
Measuring the Economic Impact of Broadband

Questions and Answers

• Please type your questions in the question box.

• The slides, transcript, and an audio recording will be posted on the BroadbandUSA website within 7 days of the webinar.

https://broadbandusa.ntia.doc.gov/past-event
Thank you for attending.
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Topic: Broadband is Revitalizing Main Street

October 16, 2019
2:00 pm EST

Registration is required for each webinar:
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Broadband TA Request Form -
https://broadbandusa.ntia.doc.gov/ntia-common-content/how-we-can-help

BBUSA Resources
• Implementing a Broadband Network Vision: A Toolkit for Local and Tribal Governments
• Community Broadband Roadmap Toolkit
• Guide to Federal Funding of Broadband Projects
• Using Partnerships to Power Smart Cities