Broadband's Economic Impact

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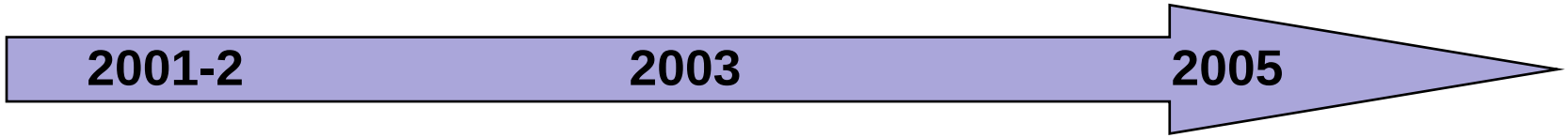
Progression of BB Impact Studies



- **1G: Prospective, hypothetical**
- **Crandall & Jackson (Verizon): BB to add $500b to GDP by 2006**
- **Pociask (New Millenium Research Council): BB to create 1.2m jobs**
- **Ferguson (Brookings): Lack of BB to lower productivity growth by 1% annually**

- **2G: Case studies, individual communities**
- **Kelley: Cedar Falls, Iowa (muni bb since 1997) improved vs. neighboring Waterloo**
- **Strategic Networks: S. Dundas, Ontario (muni fiber since 2000) grew sales, jobs, tax revenues**

- **3G: Controlled, statistical, larger geographic scope**
- **Ford & Koutsky (Applied Economic Studies): Retail sales grew in Lake County, Florida (muni bb since 2001) vs. 10 control counties**
- **This study: U.S. national scope, examines 2002,2006 economic indicators by zip code, based on FCC report of BB availability by 1999**

Key Findings

- **U.S. national data supports the conclusion that broadband positively affects economic activity**
  - Even after controlling for community-level factors known to influence BB availability and economic outcomes
  - Controls: urban, income, education, growth in previous period
- **Communities where mass-market BB was available by December 1999 experienced more rapid growth in:**
  - Jobs (employment)
  - Number of businesses (overall)
  - Share of businesses in IT-intensive sectors
- **But: salary growth rate was subsequently *lower.***
- **Property values higher in 2000 where BB available by 1999**
  - Higher market rates for rental housing in 2000
  - Rents reported more accurately than home values in Census data

Methods and Data

- **Community (zip-code) level panels**
- **Dependent variables:**
  - Employment, Wages, Industry NAICs composition, Establishment Size
- **Independent variables:**
  - Broadband: Available in community as of Dec99 – Yes/No
    - "available" may not mean available everywhere within a zip code
  - Controls: Lagged dependent, Per Capita Income, Education, Size, Type of Community (Urban), etc.
- **Issue: causality.. does BB cause or follow economic activity?**
- **Strategy: (1) Linear Regression w/ Controls; (2) Matched Panel Regressions**

Data Sources

Type of Data	Description	Availability	Source
Business Activity Indicators	Used for employment, establishments, wages (payroll), industry sector and size mix. Reported at zip code level	Collected annually; most recent data from 2006. Industry sectors coded by SIC (1994-97) and NAICS (1998-2006)	U.S. Census Bureau--ZIP Code Business Patterns (ZCBP)
Demographic Indicators/Controls	Used for income, rent, educational attainment and # of households. Reported at zip code level	Collected every 10 years; most recent data from 2000	(1) U.S. Census Bureau-2000 Decennial Census (2) GeoLytics--CensusCD ("1990 Long form in 2000 boundaries")
Geographic Controls	Used to indicate how urban or rural a zip code is, based on its proximity to metropolitan areas	Computed every 10 years; most recent coding from 2003	Economic Research Service, U.S. Department of Agriculture--Urban Influence Code (UIC)
Broadband Metrics	Reports number o high-speed Internet providers by zip-code.	Collected every 6 months (end of June and December) since 12/1999	U.S. Federal Communications Commission - Form 477 databases

Share of Zip Codes with Broadband

Growth in Broadband Availability by No. of Zip Codes

Date	Add'l Zips	Cumulative %	
Dec-99	17,683	54.44%	54.44%
Jun-00	2,725	62.83%	8.39%
Dec-00	1,970	68.90%	6.07%
Jun-01	2,026	75.14%	6.24%
Dec-01	910	77.94%	2.80%
Jun-02	957	80.89%	2.95%
Dec-02	894	83.64%	2.75%
Jun-03	899	86.39%	2.77%
Dec-03	658	88.42%	2.03%
No Broadband by December 2003	4056	11.58%	11.58%

Specifications We Estimated

$$Y(t)=AY(0)^{\alpha}e^{rt}$$

Where

$$r=r^* + \gamma BB + X\beta + \varepsilon$$

$$\ln(Y(t)/Y(0)) = g(t) = a + \gamma BB + X\beta + \varepsilon$$

Where $a=\ln A+r^*$ if $\alpha=1$

Estimated Magnitude of Impacts: 1998-2002

Growth from 1998-2002 relative to base period of 1994-1998

Economic Indicator	Results (controlled comparisons at zip code level)
Employment (Jobs)	BB added about 1-1.4% to growth rate 1998-2002
Wages	BB lowered growth rate by ~1% over the period 1998-2002
Housing Rents (Proxy for Property Values)	More than 6% higher in 2000 where BB available by 1999
Business Establishments (Proxy for Number of Firms)	BB added about 0.5-1.2% to growth rate 1998-2002
Industry Mix	BB added about 0.3-0.6% to share of establishments in IT-intensive sectors, 1998-2002 BB reduced share of small (<10 employees) establishments by about 1.3-1.6%, 1998-2002

Extending the Results to 2006.

- **Initially, we analyzed the impact of BB indicator on growth of various dependent variables over the period 1998-2002**
- **Data through 2006 has become available. How to incorporate into our analysis?**
- **What time periods?**
  - BB indicator variable as of December ‘99
  - Extend dependent variable to 98-06; or
  - Baseline 94-00, dependent variable 00-06?
  - **Obtain similar results using either specification**
- **Findings**
  - Confirm results for salaries, employment, establishments, industry mix

Broadband Impact on Growth of Selected Economic Variables 1998-2002 vs 2000-2006

(+/-=growth higher/lower in broadband communities;
*=significant at 90% or above)

	1998-2002		2000-2006	
	Zip	Matched Panel	Zip	
Employment	+*	+*	+*	
Wages	-*	-*	-*	
Establishment	+*	+*	+*	
IT-intensive share of establishments	+*	+*	+*	
Rental rates (2000)	+*	-*		

Employment: Comparison ’98-02 with ’00-’06

	lnrEmplo9802	lnrEmplo9802	lnrEmplo9802	lnrEmpl2K06	lnrEmpl2K06	lnrEmpl2K06
BB99	0.0335		**0.01037**	0.03853		**0.01089**
	[0.00517]***		**[0.00561]***	[0.00566]***		**[0.00606]***
gEmp9498		0.00073	0.00073		0.0008	0.0008
/gEmp9400		[0.00030]**	[0.00030]**		[0.00044]*	[0.00044]*
dUrban		0.05882	0.05582		0.06284	0.05972
		[0.00494]***	[0.00507]***		[0.00553]***	[0.00568]***
É						
Constant	0.01547	-0.03663	-0.04066	0.03193	-0.01121	-0.0156
	[0.00470]***	[0.03196]	[0.03208]	[0.00505]***	[0.0344]	[0.03441]
Observations	22564	22564	22564	22200	22200	22200
R-squared	0.0024	0.0269	0.0271	0.0025	0.0435	0.0436

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

- **Coefficient is nearly the same even though period is longer**
  - Implies a smaller effect per year
  - $r = r^* + \gamma BB + X\beta + \varepsilon$
- **As other zip codes get broadband, relative advantage of first movers diminishes**

Employment Impact: Matched Sample 1998-2002

Table 9C: Employment - Zip Code nnmatch regressions

		Coefficient	z-statistic	P>|Z|
N=22,390	BB99	.0144264	1.94	0.052

		Treatment BB99=1		Control BB99=0	
	Variable	Mean	Std. Dev.	Mean	Std. Dev.
Dep. Variable	lnrEmplo	0.0379408	0.238360	0.0329223	0.3475896
Independent Variables	gEmp9498	0.1832633	3.193463	0.1627447	0.9055611
	URinfl03	2.74577	2.341581	2.746226	2.342017

Impact on Salaries

- **In our previously published paper, we reported no significant change in salaries**
- **When we went back to the analysis code to look at the longer time period we found an error in the salary analysis which we have now corrected.**

Wage Impact: Zip Code Regression

Salary Growth in '98-'02 and '98-'06 vs '94-'98

	LnrSal9802	LnrSal9802	LnrSal9802	LnrSal0006	LnrSal0006	LnrSal0006
BB99	-0.00176		**-0.0108**	-0.01917		**-0.01912**
	[0.00333]		**[0.00353]*** **	[0.0035]***		**[0.00374]*** **
grSalary9498		-0.1901	-0.19094		-0.166	-0.16705
		[0.01248]***	[0.01258]***		[0.01684]***	[0.01699]***
grColl90s		-0.00003	-0.00003		-0.00005	-0.00005
		[0.00001]**	[0.00001]*		[0.00003]*	[0.00003]*
pcollege2K		0.00087	0.00092		0.00022	0.00031
		[0.00012]***	[0.00012]***		[0.00013]*	[0.00013]**
grLabor90s		0.00004	0.00004		0.00009	0.00009
		[0.00001]***	[0.00001]***		[0.00006]	[0.00006]
dUrban		0.00098	0.00352		-0.00614	-0.00168
		[0.00313]	[0.00317]		[0.00339]*	[0.00349]
pIT98		-0.09964	-0.09294		-0.06469	-0.05249
		[0.02052]***	[0.02082]***		[0.02143]***	[0.0217]**
É						
Constant	0.13421	0.16855	0.17066	0.20344	0.28877	0.29274
	[0.00306]***	[0.01607]***	[0.01595]***	[0.00318]***	[0.02288]***	[0.02283]***
Observations	22564	22564	22564	22200	22200	22200
R-squared	0.0000	0.1030	0.1035	0.0017	0.1048	0.1062

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

- **Results for '00-'06 vs '94-'00 are similar**
- **Impact per year is smaller over the longer period**

Why Is the Impact on Average Salaries Negative?

- **Finding is robust across multiple time periods, statistical approaches**
- **Hypotheses**
  - Broadband permits more part time work/work from home
    - AvSalary ≡ Payroll/Employees where Employees includes part time workers
  - Broadband enlarges labor pool by allowing telecommuters thus driving wages down
  - Broadband allowed firms to reduce middle managers who earned above average salaries

Establishment Growth: Comparison of ’98-02 and ’00-’06

	lnrEst9802	lnrEst9802	lnrEst9802	lnrEst0006	lnrEst0006	lnrEst0006
BB99	0.0268		**0.00536**	0.0603		**0.02873**
	[0.00268]***		**[0.00288]***	[0.00327]***		**[0.00344]***
grEst9498		0.00961	0.00959		0.01395	0.01383
		[0.00401]**	[0.00401]**		[0.00521]***	[0.0052]***
dUrban		0.04483	0.04328		0.06745	0.05915
		[0.00262]***	[0.00271]***		[0.00312]***	[0.00321]***
grLabor90s		0.00006	0.00006		0.00008	0.00007
		[0.00001]***	[0.00001]***		[0.00003]***	[0.00003]***
É						
Constant	0.0267	0.01458	0.0125	0.03258	0.02873***	0.03640*
	[0.00239]***	[0.01313]	[0.01331]	[0.00289]***	[0.00344]	[0.01988]
Observations	22564	22564	22564	22564	22564	22564
R-squared	0.0054	0.0623	0.0625	0.0179	0.1179	0.1212

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

- **Impact on Establishment growth <u>much</u> larger over ’00-’06 time period**
  - BB allowed persons laid off during downturn to more easily start new businesses?

Firm Composition:
Establishments in IT-intensive Sectors: 2002 and 2006

	ptotIT02	ptotIT02	ptotIT02	pIT06	pIT06	pIT06
BB99	0.04441		**0.00579**	0.03673***		**0.00501*** **
	[0.00125]***		**[0.00085]*** **	[0.00122]		**[0.00101]**
pIT98		0.86417	0.86072		0.68202***	0.67909***
		[0.00596]***	[0.00608]***		[0.00805]	[0.00820]
grColl90s		0.00001	0.00001		0.00001***	0.00001***
		[0.00000]***	[0.00000]***		[0.00000]	[0.00000]
pcollege2K		0.00065	0.00062		0.00109***	0.00107***
		[0.00003]***	[0.00003]***		[0.00004]	[0.00004]
dUrban		0.00302	0.00166		-0.00554***	-0.00669***
		[0.00075]***	[0.00076]**		[0.00089]	[0.00089]
grpIT9800		0.07921	0.07935		0.05372***	0.05387***
		[0.00239]***	[0.00238]***		[0.00233]	[0.00232]
É						
Constant	0.19604	0.01423	0.01315	0.17278***	0.01363***	0.01265**
	[0.00103]***	[0.00390]***	[0.00382]***	[0.00101]	[0.00520]	[0.00509]
Observations	22564	22564	22564	22105	22105	22105
R-squared	0.05	0.76	0.76	0.04	0.061	0.61

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

- **Shift in percent share of IT related firms occurred entirely by 2002**

Share of Establishments Which Are Less than 10 Employees 2002 and 2006

	psm02	psm02	psm02	psm06	psm06	psm06
BB99	-0.06588***		-0.01337***	-0.05991***		-0.01205***
	[0.00139]		[0.00110]	[0.00142]		[0.00121]
psm98		0.80803***	0.79539***		0.75305***	0.74166***
		[0.00555]	[0.00584]		[0.00615]	[0.00643]
%Total Estb IT Intensive		-0.04763***	-0.04279***		-0.05644***	-0.05208***
		[0.00603]	[0.00598]		[0.00687]	[0.00687]
grColl90s		0	0		0	0
		[0.00000]	[0.00000]		[0.00000]	[0.00000]
% people 25+ with college degree or higher 2000		-0.00002	0.00005		0.00012***	0.00018***
		[0.00003]	[0.00003]		[0.00004]	[0.00004]
dUrban		-0.00962***	-0.00702***		-0.00915***	-0.00681***
		[0.00096]	[0.00096]		[0.00107]	[0.00106]
Constant	0.83480***	0.17234***	0.18593***	0.82320***	0.20957***	0.22182***
	[0.00119]	[0.00831]	[0.00833]	[0.00124]	[0.00788]	[0.00799]
State Dummies	No	Yes	Yes	No	Yes	Yes
R-squared	0.09971	0.69774	0.70081	0.08261	0.61792	0.62041
N	22564	22564	22564	22564	22564	22564

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

Impact on Rents: Zip Code Regressions

Table 11B: Zip Code Rent Regressions

	(11B1) lnRent2K	(11B2) lnRent2K	(11B3) lnRent2K	(11B4) lnRent2K
BB99	0.26704	0.10341		0.06563
	[0.00445]***	[0.00507]***		[0.00391]***
lnRent90		0.57686	0.41795	0.40166
		[0.01315]***	[0.01646]***	[0.01646]***
grFInc90s			0.00007	0.00007
			[0.00002]***	[0.00002]***
grLabor90s			0.00016	0.00015
			[0.00007]**	[0.00006]**
dUrban			0.16377	0.14929
			[0.00550]***	[0.00511]***
…				
Constant	6.03934	2.7445	3.73733	3.78396
	[0.00348]***	[0.07570]***	[0.10080]***	[0.09939]***
Observations	22390	22390	22390	22390
R-squared	0.1278	0.5439	0.6165	0.6226

Robust standard errors in brackets. State dummies are not shown in table. * significant at 10%; ** significant at 5%; *** significant at 1%

Very Preliminary Analysis on Impact of FTTH

- **In 2002 there were 21 zip codes with significant deployment of FTTH***
  - Municipal
  - Independent telcos
  - New subdivisions
  - Generally less than the total area of the zip code
- **Looked for impact in the subsequent period from ‘02-’06**
- **Used matched sample analysis on these 21 zip codes**
- **Findings:**
  - Employment growth rate *decreased* by 0.2%; significant at the 94% level
  - No other impacts anywhere close to significant.

*Data supplied by Render, Vanderslice and Associates from studies done for FTTH Council

Further Conclusions and Results

- **Zip Code regressions yield strong results, but causality remains an issue**
- **Impact of Broadband availability on economic performance is mixed**
  - More jobs, establishments, but lower salaries [payroll/employees].
- **Are the differences we see**
  - Temporary
    - the “haves” prospering at the expense of the “have nots”; or
  - Permanent
    - Broadband stimulates growth of the economy as a whole
- **Smaller coefficients in 2006 suggest first explanation is correct**
- **Need better data on usage: Penetration and available speeds**
- **Ability to observe effects will improve with aging of data (2010 Census?)**
- **Need better data on firm organization: Enterprise sample data**
  - Establishment size and distribution of work

Thank you

Merci