

### Measuring the Economic Impact of Broadband: State of the Research

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### Research on economic impact of broadband has been conducted across four areas



# The study of broadband deployment impact on jobs and output is fairly reliable, although limited by availability of I/O matrices



- Not to be confused with top-down multipliers
- Focused on country specific impact based on input-output analysis
- Therefore, limited by availability of I/O matrices
- Examples: Crandall. Jackson and Singer (2003); Atkinson, Castro and Ezell (2009); Strategic Networks Group (2003); Katz, Zenhausern, and Suter (2008); Katz and Suter (2009); Katz, Zehausern and Suter (2010)

### The study of broadband economic spill-overs originally started with single variable models



- Examples for a single country: Gillet, Lehr and Sirbu (2006); Crandall, Lehr and Littan (2007); Thompson and Garbacz (2008); Shideler, Badasyan and Taylor (2007); Katz, Zehausern and Suter (2010)
- Examples for cross-sections: Czernich et al. (2009); Qiang and Rosotto (2009); Ng, Lye and Lim (2013)
- Problems of reverse causality, attempted to be addressed through cross-lagged samples

### Structural models have been constructed in an attempt to control for reverse causality

#### IMPACT MODEL OF INCREASING BROADBAND PENETRATION ON GDP GROWTH

FUNCTION	EQUATION
Aggregate Production Function	$\Delta GDP_{it} = \alpha_1 \Delta Fixed \ Capital_{it} + \alpha_2 \Delta \ Labor \ Force_{it} + \alpha_3 \Delta \ Oil \ Price_{it} + \alpha_4 \Delta \ Broadband \ Penetration_{it} + \epsilon_{it} + Year \ Fixed \ Effect_t$
Demand function	$ \Delta Broadband \ Penetration_{it} \\ = \alpha_1 \Delta \ Broadband \ Price_{it} + \alpha_2 \Delta \ Household \ Income_{it} + \epsilon_{it} \\ + \ Year \ Fixed \ Effect_t $
Supply function	$\Delta Revenues of Broadband Companies_{it} = \alpha_1 \Delta Household Income_{it} + \alpha_2 \Delta Urban Population_{it} + \epsilon_{it}$
Output function	$\Delta Broadband Penetration_{it} = \alpha_1 \Delta Revenues of Broadband Companies_{it} + \epsilon_{it}$

### Structural models were first developed with cross-sectional samples, gradually moving to country specific studies

- History of telecom impact structural models:
  - Roller and Waverman (2001): impact of wireline telephony
  - Koutroumpis (2009): impact of broadband on OECD countries
  - Gruber and Koutroumpis (2011): impact of wireless telephony on 125 countries
- Country specific broadband studies:
  - Katz and Koutroumpis (2012); Panama and Philippines
  - Katz and Callorda (2012); Ecuador
  - Katz and Koutrroumpis (2010; 2013): Senegal, Mali, Niger and Cote d'Ivoire
- Issues: length of time series to generate enough observations

#### VALUE OF BROADBAND PENETRATION COEFFICIENT VS. PENETRATION

	Philippines Fixed BB	Panama Fixed BB	Ecuador Fixed BB	Senegal Fixed	Senegal Mobile	Mali, Cote d'Ivoire, Niger
Coefficient	No effect	0.045	0.052	No effect	0.022	Not enough
Penetration	0.5 %	2 %	1.5 %	0.49 %	3.42 %	observations

### Recent analytical trend is to rely on microdata analysis



Examples: DiMaggio and Bonikowski (2008) impact of internet on income in US; Navarro (2011) impact of internet on male income in Latin America; De Los Rios (2010) impact on household income in Peru; Atasoy (2011) impact of broadband on US job market; Katz and Callorda (2013) impact of broadband on individual income in Ecuador
Issues: data clean-up, limited theoretical framework

### Microdata models estimate the impact of broadband deployment (treatment) on economic variables such as individual income

• The model utilized estimates the impact of treatment on the Y variable (individual income) as follows:

 $Y_i = \alpha + \gamma Tratamiento_i + \beta X_i + u_i + t_i + e_i$ 

- Where i is each individual, Y is the dependent variable (income), γ estimates the causal impact of treatment (assuming the value of 1 if the individual was treated, 0 if it was not)
- X is a vector of control variables including age, genre, educational level, health coverage (as an indicator of belonging to formal economy), type of occupation and position in household
- u is a fixed effect by province where individual resides
- t is a yearly fixed effect
- e is the error term

### Microdata-based models allow the identification of specific effects with robst results: example from Ecuador

#### ECUADOR: IMPACT ON INDIVIDUAL MONTHLY INCOME RESULTING FROM BROADBAND DEPLOYMENT

	US\$ (Over two years )	Percent increase (over two years)	Annual increase
Increase in individual income for the total sample	US\$ 25.76	7.48%	3.67%
Increase for individuals that already owned a computer	US\$ 38.36	8.00%	3.92%
Increase for individuals that already were Internet users	US\$ 51.86	10.27%	5.01%

While the overall effect is larger for men than for women, gender difference disappears if Internet was used before broadband had been adopted

Source: Katz and Callorda (2013)

# Job creation impact research is affected by the complexity of multiple effects

- It is wrong to come up with aggregate evidence of job creation because there are multiple effects at play
  - In Germany (2006-10), broadband deployment created jobs in high penetration areas and had a negative impact in low penetration areas (Katz et al, 2010)
  - In sub-urban America, broadband created jobs in health care, wholesale trade, and some services, due to enterprise relocation (Katz et al, 2010)
  - In some sectors, broadband destroys job due to capital-labor substitution (Thompson et al, 2009)
  - Job creation in some Zip codes in the US is affected by diminishing impact due to saturation effects (Gillet et al, 2006)
  - In EU, multiple factors at work (innovation, outsourcing, capital/labor substitution (Fornfeld et al, 2009)
- Beyond construction effects, we are still at the infancy of broadband job contribution effects (sometimes tainted by political considerations)

### In sum, we are gradually reaching more specificity and granularity on findings

- Moving from cross-sectional studies to country specific
- Moving to wireless broadband once time series become long enough
- Still in need to gain a better understanding of all systemic effects regarding job creation effects
- One fundamental issue: the broadband independent variable does not capture all potential effects; need to move on to indices that capture usage data in addition to broadband penetration (digitization?)