Estimating Broadband Demand and its economic impact in Latin America

Dr. Raúl L. Katz (*)
Adjunct Professor, Division of Finance and Economics

Director, Business Strategy Research
Columbia Institute of Tele-information

Alternatives for Broadband Infrastructure and Access Development

Brasilia
November 16, 2009

Agenda

- What do we know about the economic impact of broadband?

- The current situation of broadband in Latin America

- An estimation of broadband demand and its employment impact in Latin America

- Conclusions and research agenda

Our understanding of the economic impact of broadband

WHAT WE KNOW	WHAT WE ARE STARTING TO UNDERSTAND	WHAT WE KNOW WE DON'T KNOW YET
●The construction of broadband network has important direct and indirect employment effects ●The induced effects of network construction magnify the total impact of network deployment ●Revenue "leakage" varies by country ●Once broadband is deployed positive externalities have also significant economic impact	●How many jobs can be lost as a result of broadband induced capital-labor substitution? ●What is the economic impact in advanced industrialized vs. rural regions?	●What is the relationship between faster broadband speeds and economic output and employment? ●Is there a broadband saturation point beyond which network externalities tend to substantially diminish?

What we know: Three types of network construction effects exist

EFFECT	DESCRIPTION	EMPLOYMENT EXAMPLES
Direct jobs and output	• Employment and economic production generated in the short term in the course of deployment of network facilities	• Telecommunications technicians • Construction workers • Civil and RF engineers
Indirect jobs and output	• Employment and production generated by indirect spending (or businesses buying and selling to each other in support of direct spending)	• Metal products workers • Electrical equipment workers • Professional Services
Induced jobs and output	• Employment and production generated by household spending based on the income earned from the direct and indirect effects	• Consumer durables • Retail trade • Consumer services

What we know: Network construction effects and multipliers are significant

NETWORK CONSTRUCTION EFFECTS OF BROADBAND

COUNTRY	STIMULUS INVESTMENT (USD billion)	NETWORK DEPLOYMENT JOBS ESTIMATE				MULTIPLIERS	
		DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I (*)	TYPE II (**)
UNITED STATES	$ 6,390	37,000	31,000	60,000	128,000	1.83	3.42
SWITZERLAND	~$ 10,000	~80,000	~30,000	N.A.	~110,000	1.38	N.A.
GERMANY	$ 47,660	281,000	126,000	135,000	542,000	1.45	1.94
UNITED KINGDOM	$ 7,463	76,500	134,500		211,000		2.76
AUSTRALIA	$ 31,340				~200,000		

Sources: Katz, R. and Suter, S. (2009). *Estimating the economic impact of the US broadband stimulus plan, Columbia Institute for Tele-Information working paper;* Katz, R., P. Zenhäusern, S. Suter, P. Mahler and S. Vaterlaus (2008). *Economic Modeling of the Investment in FTTH* in Switzerland, unpublished report; *Libenau, J., Atkinson, R. (2009) The UK's digital road to recovery. LSE and ITIF; Australian government.* Katz, R., S. Vaterlaus, P. Zenhäusern, S. Suter and P. Mahler (2009). *The Impact of Broadband on Jobs and the German Economy*; Columbia Institute for tele-Information working paper
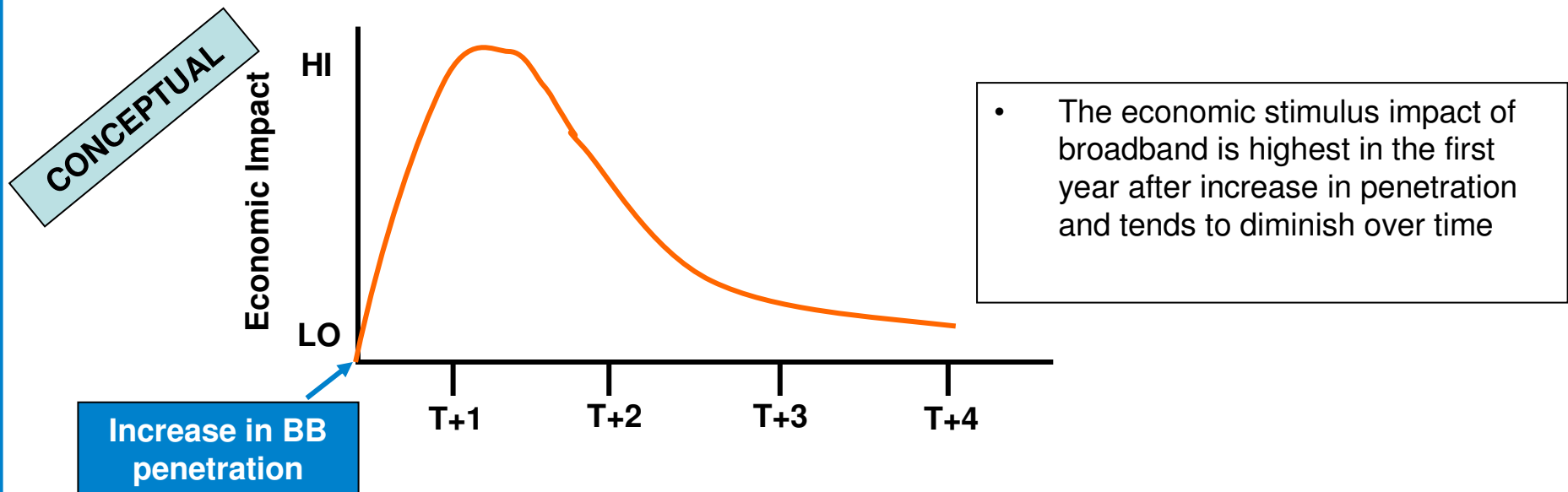
(*) (Direct + indirect)/direct
(**) (Direct + indirect + induced)/direct

What we know: However, the externalities derived from broadband are significantly higher

| EFFECT	DESCRIPTION	EMPLOYMENT EXAMPLES
Productivity	• Improvement of productivity as a result of the adoption of more efficient business processes enabled by broadband	• Marketing of excess inventories • Optimization of supply chains
Innovation	• Acceleration of innovation resulting from the introduction of new broadband-enabled applications and services	• New applications and services (telemedicine, Internet search, e-commerce, online education, VOD and social networking) • New forms of commerce and financial intermediation
Value chain recomposition	• Attract employment from other regions as a result of the ability to process information and provide services remotely	• Outsourcing of services • Virtual call centers • Core economic development clusters

What we know: Aggregate economic impact of broadband in terms of network externalities have been found to be significant

- Our analysis for Germany estimated the impact of increase in broadband penetration on rate of economic growth

    - Due to the effect of high broadband penetration growth in 2001, time intervals were calculated for three stages: 2000-1, 2001-2, 2002-3

    - In addition, GDP and employment data was adjusted through an Hodrick-Prescott filter to time series in order to normalize for trends and business cycle effects

- Aggregate results for the whole territory indicate that broadband penetration has a significant short-term effect on economic growth
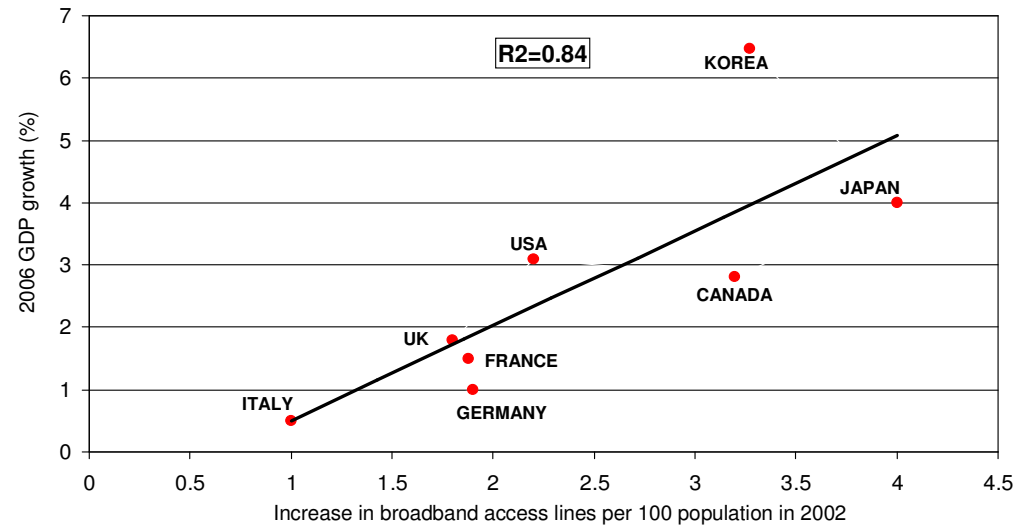
CONCEPTUAL

Economic Impact

HI

LO

Increase in BB penetration

T+1   T+2   T+3   T+4

- The economic stimulus impact of broadband is highest in the first year after increase in penetration and tends to diminish over time

SPAIN AUTONOMOUS COMMUNITIES: RELATIONSHIP BETWEEN BROADBAND PENETRATION AND EMPLOYMENT GROWTH

$y = 0.0009x - 0.0269$
$R^2 = 0.4214$

Total employment Growth 2003-05

2003 - Broadband Enterprise penetration (%)
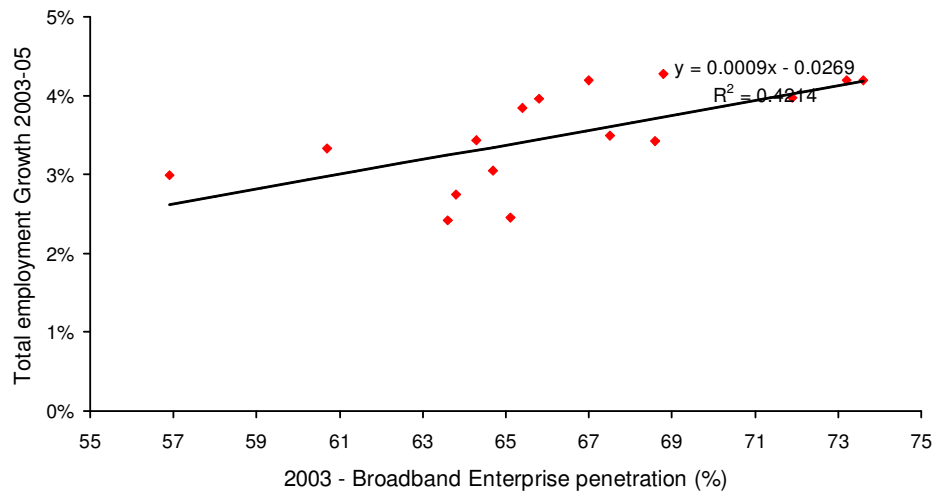
Sources: Katz (2008)

INDUSTRIALIZED COUNTRIES: RELATIONSHIP BETWEEN BROADBAND PENETRATION AND ECONOMIC GROWTH

R2=0.84

KOREA
JAPAN
USA
CANADA
UK
FRANCE
ITALY
GERMANY

2006 GDP growth (%)

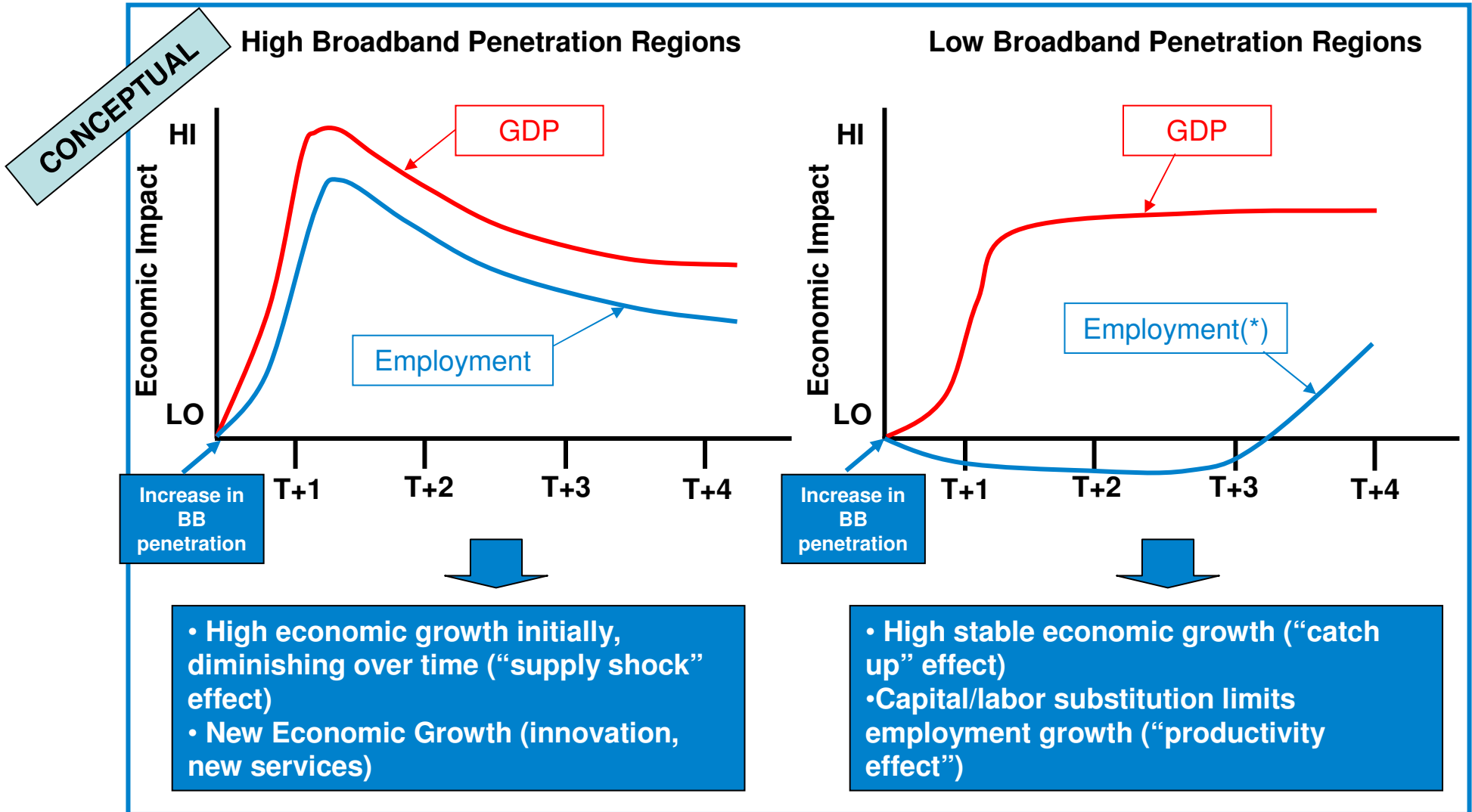Increase in broadband access lines per 100 population in 2002

Sources: Gentzoglanis (2007)

What we know: A growing body of econometric research conducted at the regional, national and international level confirm these findings

COUNTRY	STUDY	DATA	EFFECT
Germany	●Katz et al. (2009)	2000-2006 for Landkreise	An incremental penetration of broadband of 1% yields 0.026% incremental GDP growth
United States	●Lehr et al. (2005)	1998-2002 for US postal codes	Availability of broadband at the community level added over 1% to employment growth and 0.5% growth of businesses
	●Crandall et al. (2007)	For 48 US states	For every one percentage point increase in broadband penetration in a state, employment is projected to increase by 0.2 to 0.3 percent a year (…) assuming the economy is not already at "full employment"
	●Shideler et al. (2007)	Disaggregated county data for state of Kentucky for 2003-4	An increase in broadband penetration of 1% contributes to total employment growth ranging from 0.14% to 5.32% depending on the industry
	●Thompson et al. (2008)	2000-2006 for 48 US states	Positive employment generation effect varying by industry
OECD	●Koutroumpis (2009)	2002-2007 for 22 OECD countries	An increase in broadband penetration of 1% yields 0.025% increase in economic growth

What we are starting to understand: There is growing evidence that the economic impact of broadband deployment varies by region

CONCEPTUAL

High Broadband Penetration Regions

Low Broadband Penetration Regions

- **High economic growth initially, diminishing over time ("supply shock" effect)**
- **New Economic Growth (innovation, new services)**

- **High stable economic growth ("catch up" effect)**
- **Capital/labor substitution limits employment growth ("productivity effect")**

(*) Results are at a low significance level

What we are starting to understand: Emerging evidence of differential impact of broadband by region or industry

| COUNTRY	STUDY	DATA	EFFECT
Germany	●Katz et al. (2009)	2000-2006 for Landkreise	An increase of 1% in broadband penetration yields an incremental annual GDP growth rate of 0.61 percentage points for low penetrated Landkreise and 0.64 percentage points for high penetrated Landkreise
United States	●Lehr et al. (2005)	1998-2002 for US postal codes	The relation between broadband penetration and employment is not linear because the technology is adopted within a state first by those who get the greatest benefit (while) late adopters within a state will realize a lesser benefit
	●Thomson et al. (2008)	2000-2006 for 48 US states	Pointed out to the potential existence of a substitution effect between capital and labor that is stimulated by broadband deployment; which could materialize differentially by industry
	●Shideler et al. (2007)	Disaggregated county data for state of Kentucky for 2003-4	The broadband impact is negative and significant (0.34%) for Tourism, which suggests that broadband deployment enables firms to substitute technology for labor in this industry
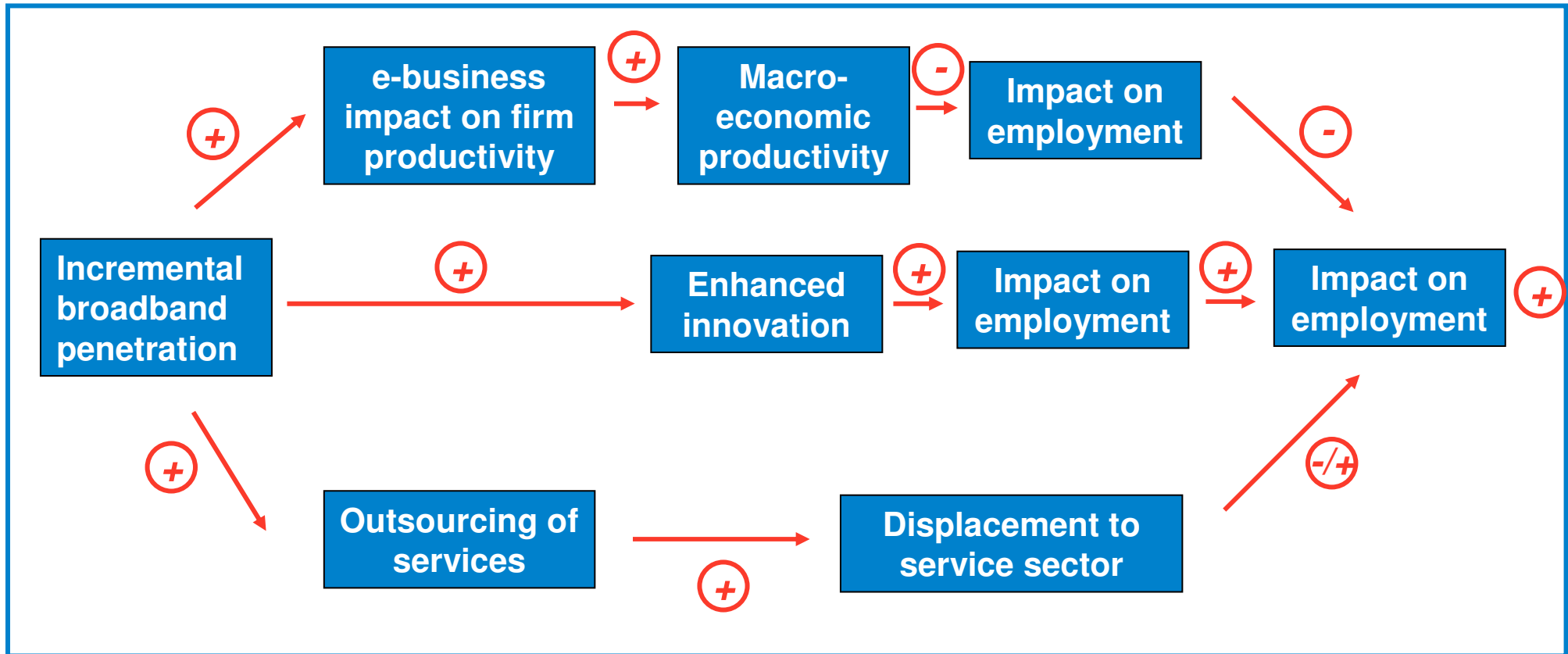
Note: This causality chain was adapted from a model originally developed by Fornefeld et al., 2008 in a report for the European Commission

- Is there a linear relationship between broadband adoption and economic impact?

- Or are we in the presence of a more complex causality effect?

- Following the "critical mass", the impact of broadband on employment only becomes significant once the adoption of the platform achieves high penetration levels.

- At the other end of the diffusion process, a saturation point could exist beyond which we achieve decreasing returns

- Atkinson at al. (2009) also point out that network externalities do decline with the build out of networks and maturing technology over time.

- Hypothesis: the strength of the relationship is highest once the technology has achieved a certain critical mass but before it reaches saturation

BROADBAND PENETRATION IMPACT

Saturation point

Critical Mass threshold

INCREASE EMPLOYMENT

BROADBAND PENETRATION
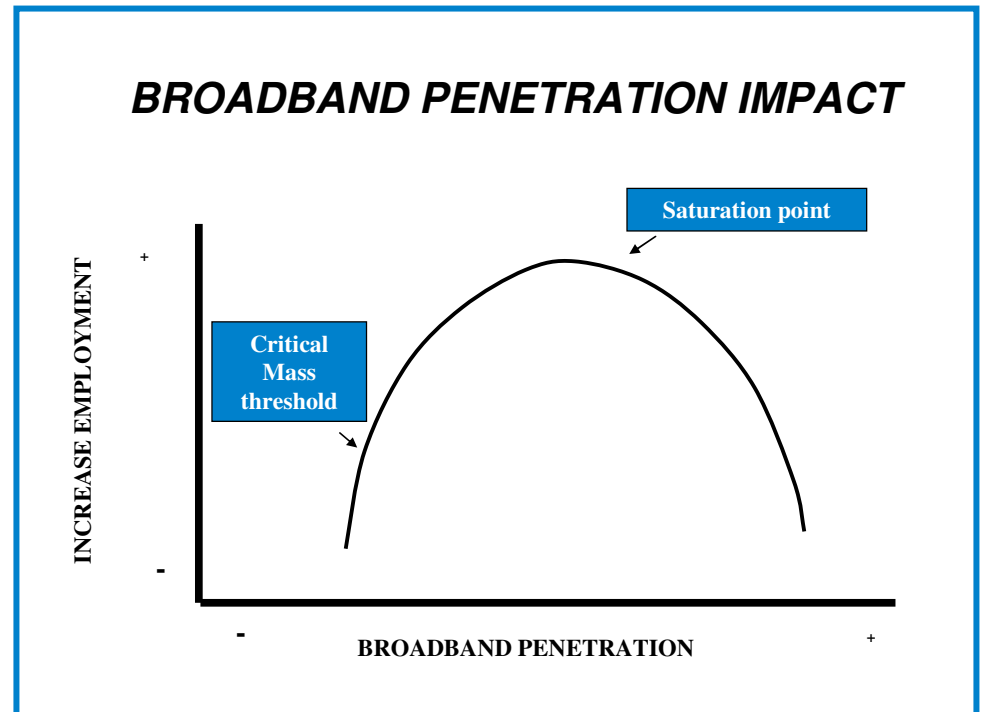
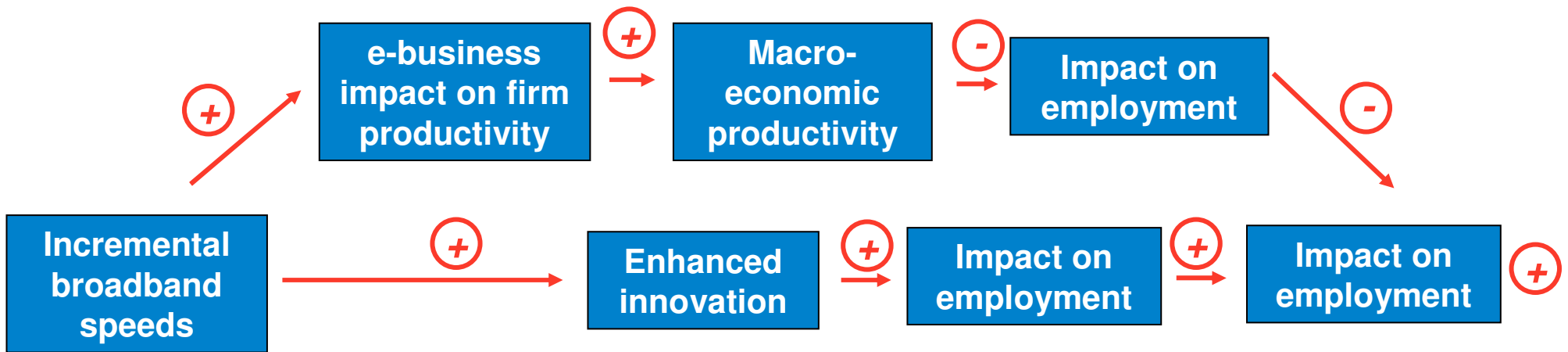# What we know we don't know: Two answers to potential saturation

Kentucky study (Shideler et al., 2007): Yes

- Employment growth is highest around the mean level of broadband saturation at the county level, driven by the diminishing returns to scale of the infrastructure
- According to this, a critical amount of broadband infrastructure may be needed to sizably increase employment, but once a community is completely built out, additional broadband infrastructure will not further affect employment growth

German study (Katz et al, 2009): we do not know

- Our estimates were all based on a linear model. This linear relationship was tested under different model specifications
  - Three-year aggregates
  - One-year impact
  - Different starting points in the series
- While we believe that some saturation effect might reduce the overall impact, our analysis was not able to identify a consistent trend
- Unfortunately, so far the low confidence on the coefficients prevents us from establishing a saturation effect

What we know we don't know: What is the relationship between faster speeds and improved QOS and economic output?

Incremental broadband speeds **(+)** → e-business impact on firm productivity **(+)** → Macro-economic productivity **(-)** → Impact on employment **(-)** →

Incremental broadband speeds **(+)** → Enhanced innovation **(+)** → Impact on employment **(+)** → Impact on employment **(+)**

Application	Download speeds		
	500 Kbps	5 Mbps	50 Mbps
Google home page	0.3 sec	0.03 sec	0.003 sec
10 Mbs worksheet	150 sec	16 sec	1.6 sec
High quality videostreaming	Very low resolution	Medium resolution	High resolution
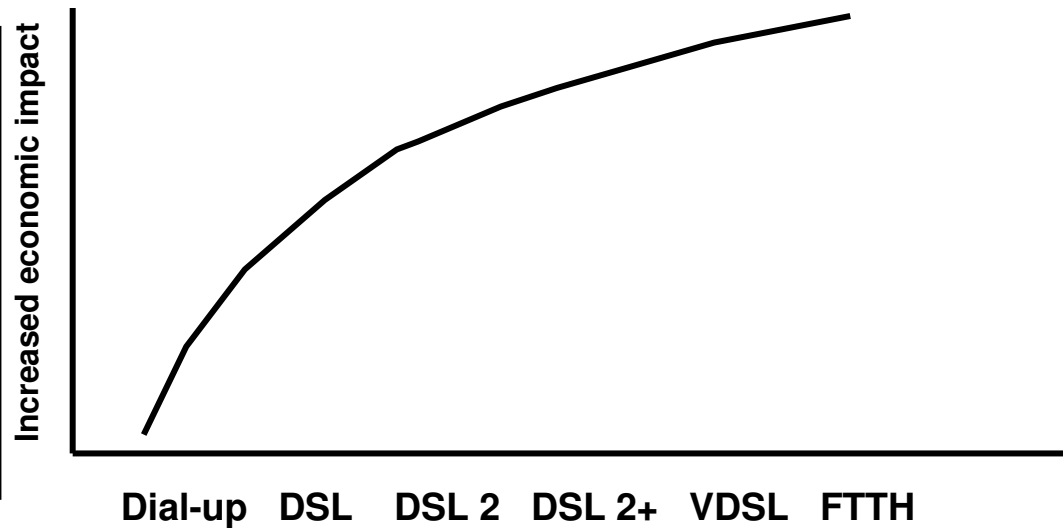
Source: SQW (2006)

Increased economic impact

Dial-up   DSL   DSL 2   DSL 2+   VDSL   FTTH

- Broadband adoption is found to boost productivity but no productivity differences were found across broadband type (slow vs. fast speed)

- However, the authors warn about several issues at work:

  – The split between fast and slow broadband is based on the distinction between cable and other broadband types which may be a poor representation of differing internet speeds (e.g. "fast" broadband includes technologies with anything from average download speeds of 8Mbps to speeds of up to 1Gbps; by contrast, the average "slow" download speed is 5Mbps)

  – Not all survey respondents may be aware of the technical nature of their firm's broadband connectivity type, answering questions in a biased way

  – Even if the cable/other distinction is meaningful, firms may have only recently adopted cable and are yet to achieve the full productivity benefits ("Jorgesen lag effect")

  – The productivity benefits of moving to fast broadband may only be relevant to a small proportion of firms, and so the full future benefits may not be apparent in the aggregate data

- In conclusion, a lot of work still needs to be done (by industry sector, by technology, by time lag, etc.)

In sum, broadband deployment should be stimulated because of its economic impact

- Generate jobs and output as a result of the construction of networks
  - Estimates for network construction jobs are fairly robust and consistent with prior research
  - Output multiplier: every Euro invested in infrastructure, generates 0.90 Euros in domestic value added
- Promote innovation, and creation of new businesses once the networks are deployed
  - Accelerate development of core regions
  - Attract new industries, with employment potential
- However, differential impact across regions prompts the question of where to focus
  - It would appear that, in the short term, investment in advanced industrialized regions yields stronger impact
  - This needs to be balanced against a social policy oriented toward fostering digital inclusion
- Beyond social targets (e.g. universal broadband access >2Mbps), it might dangerous to set up penetration objectives because we do not know yet what is optimal
- It is imperative to launch studies to assess incremental economic impact of ultra broadband in countries with advanced deployment
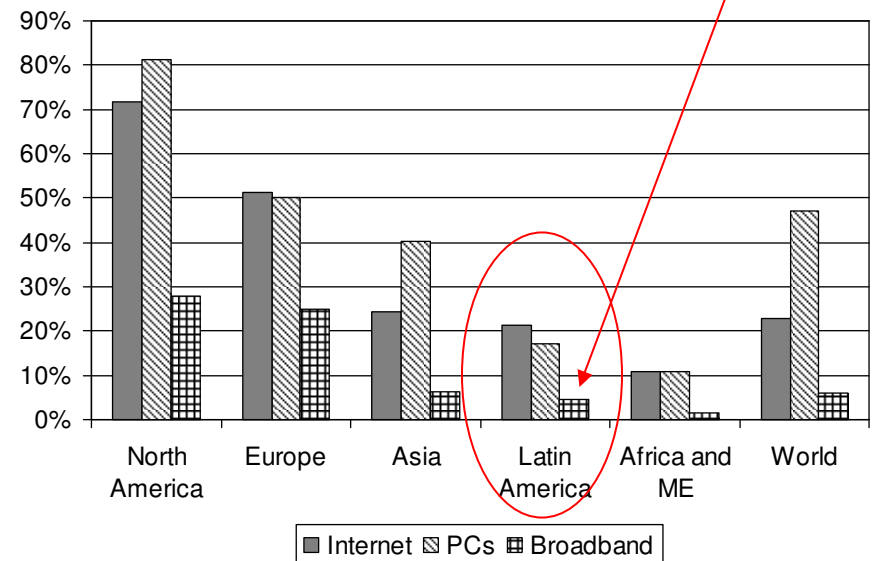
Agenda

- What do we know about the economic impact of broadband?

- The current situation of broadband in Latin America

- An estimation of broadband demand and its employment impact in Latin America

- Conclusions and research agenda

Latin America lags in broadband penetration per population

VOICE TELEPHONY (2008)
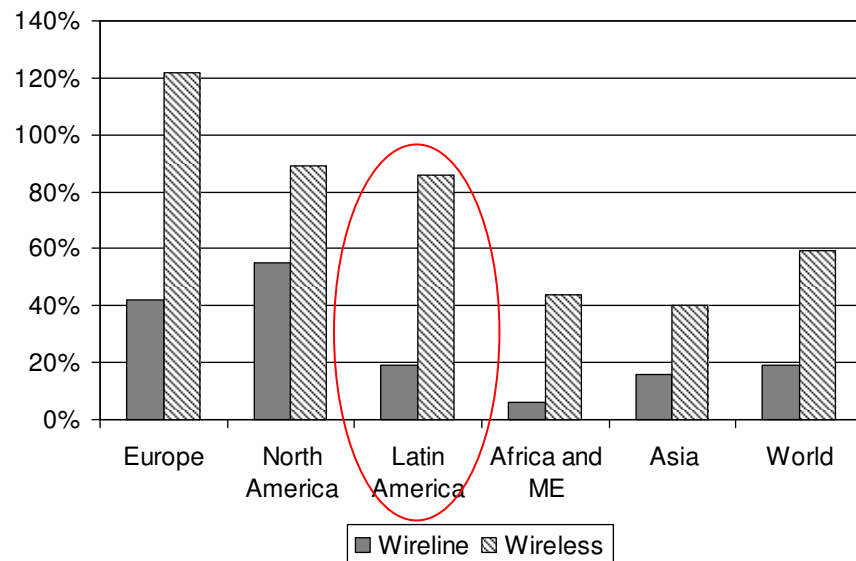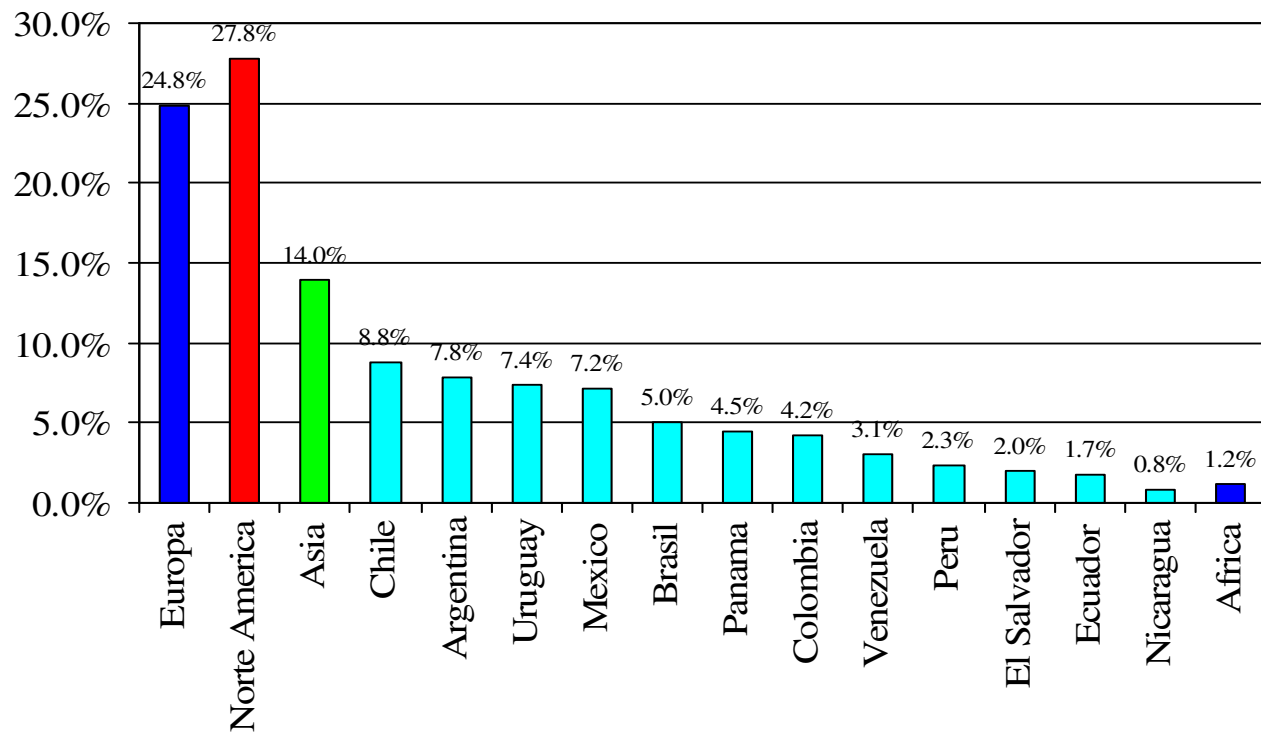

INTERNET USAGE, PC AND BROADBAND (2008)

Sources: ITU; regulatory authorities; compiled by the author

BROADBAND COMPARATIVE PENETRATION (2008)
(PER 100 POPULATION)

Sources: IDC; UBS; UIT; OCDE; analysis by the author

Furthermore, penetration statistics need to be reduced when adjusted by speed standards

BROADBAND DOWNLOAD SPEEDS BREAKDOWN

|	<256 kbps	256-512 kbps	512 kbps-1 mbps	>1 mbps
Argentina	1.4 %	12.4 %	39.0 %	47.2 %
Brazil	11.4 %	24.8 %	30.1 %	33.7 %
Chile	2.4%	9.4 %	24.8 %	63.4 %
Colombia	11.4 %	11.4 %	51.0 %	26.2 %
Peru	10.3%	41.7 %	38.3 %	9.7 %

Sources: IDC/Cisco

ADJUSTMENT OF BROADBAND PENETRATION

Country	Number of Broadband lines	Penetration	Adjustment according to the ITU definition (>1.5MBPS)		Adjustment according to the OECD definition (>256 KBPS)	
			Lines	Penetration	Lines	Penetration
Argentina	3,185,300	7.9 %	1,504,780	3.8%	3,141,365	7.9 %
Brasil	10,098,000	5.3 %	3,403,026	1.8%	8,948,917	4.6 %
Chile	1,426,400	8.4 %	905,026	5.6%	1,391,970	8.2 %
Colombia	1,902,800	4.8 %	498,665	1.1%	1,686,274	3.7 %
Perú	725,600	2.5 %	70,058	0.3%	650,538	2.3 %

LATIN AMERICA: BROADBAND DIFFUSION (1998-2008)
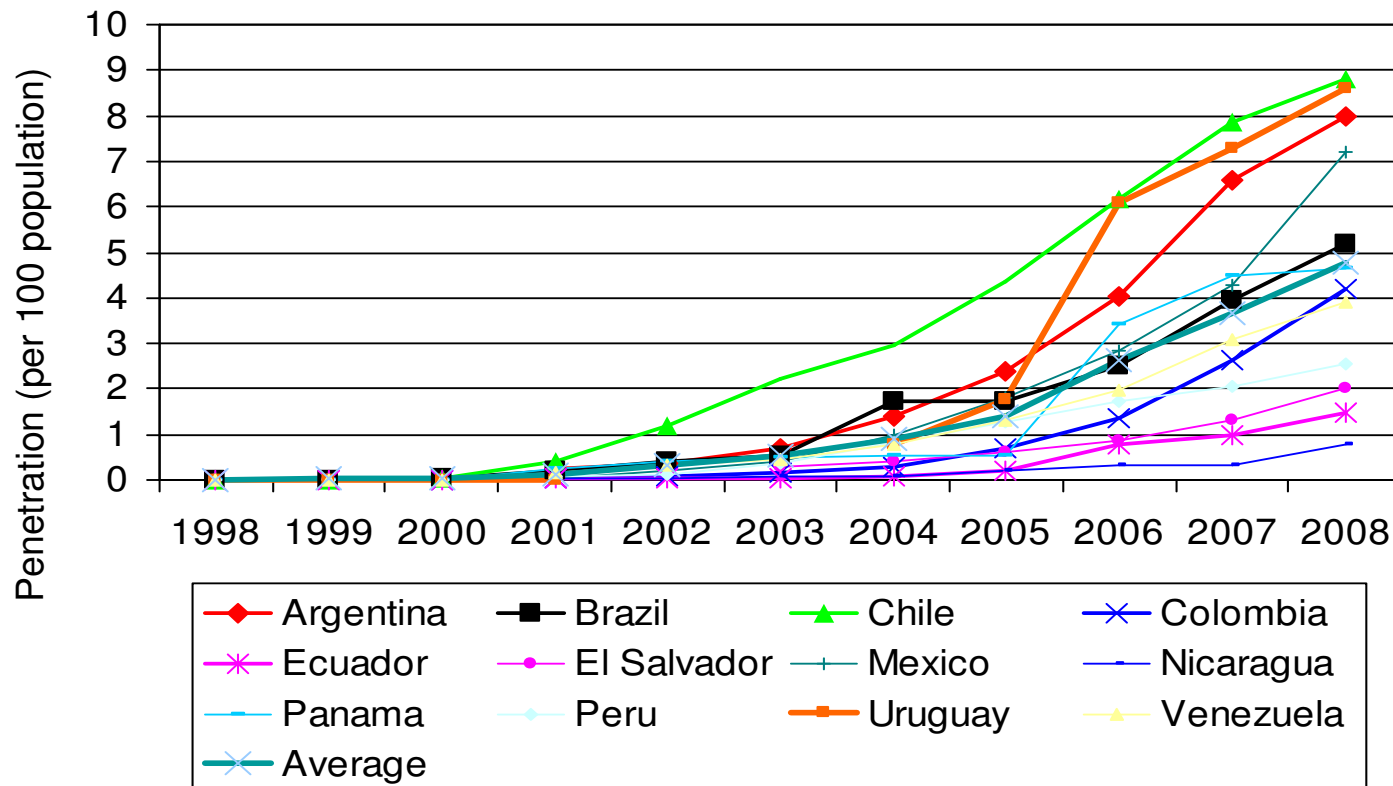
*Sources: ITU; Regulatory authorities*

Despite this growth, geographic distribution remains extremely uneven

Country	National Penetration	Penetration >national	Penetration <national
Argentina	7.9 %	Buenos Aires capital: 30.7 %	Santa Fe: 7.52 %
		Buenos Aires provincia: 7.55 %	Córdoba: 7.77 %
			Mendoza: 3.88 %
Brazil	5.3 %	Sao Paulo 9.12%	Nordeste: 1.09 %
		Rio Grande do Sul: 6.6%	Sud este: 6.24 %
			Centro Oeste: 5.49 %
			Norte: 2.96 %
Chile	8.4 %	Región Metropolitana: 12 %	Quinta región: 8.2 %
		Primera región: 14.2 %	Tercera región: 8.1 %
		Segunda región 12.9 %	Cuarta región: 5.3 %
			Octava región: 6.0 %
			Sexta-séptima región: 4.3 %
			Novena región: 5.3 %
			Décima región: 6.2 %
			Undécima región: 5.5 %
			Duodécima región: 3.8 %
Colombia	4.2 %	Bogota: 8.8 %	Medellín: 8.7 %
		Barranquilla: 5.4 %	Cali: 5.2 %

# To sum up, a dualistic deployment pattern

- In general terms, penetration is highest in large cities with levels close to that of industrialized countries

- But big drop in marginal areas

- Quality is still relatively low

- Highest broadband penetration is linked to platform-based competition models

COMPARATIVE BROADBAND PENETRATION
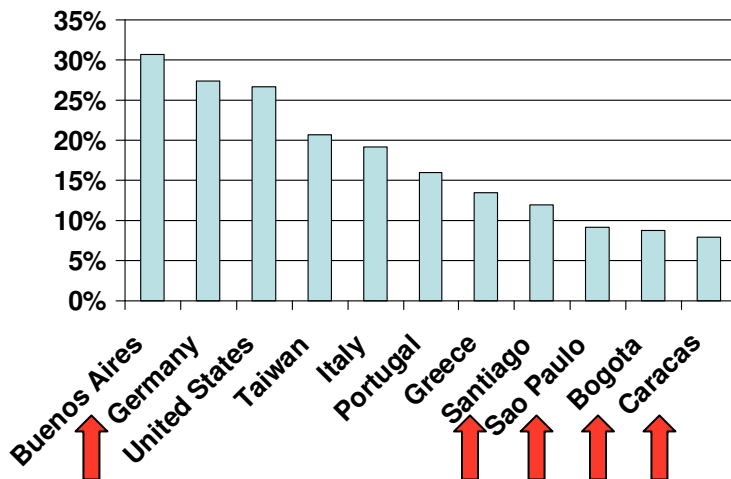
BROADBAND PENETRATION VS. COMPETITION MODELS
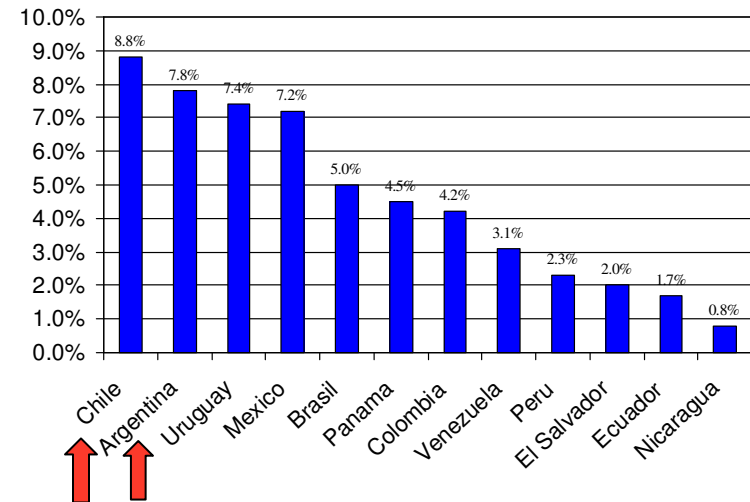
Agenda

- What do we know about the economic impact of broadband?

- The current situation of broadband in Latin America

- An estimation of broadband demand and its employment impact in Latin America

- Conclusions and research agenda

Our demand estimates are based on the relationship between level of economic development and broadband penetration
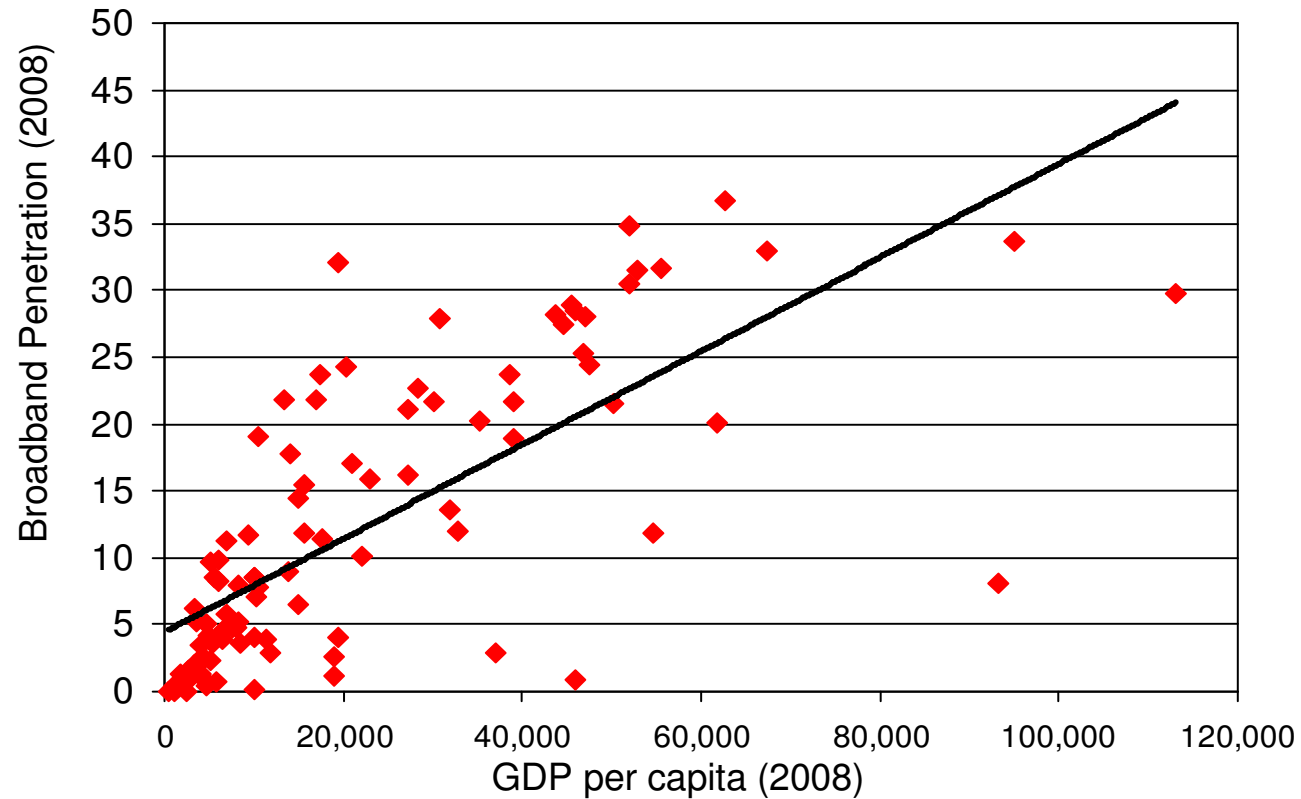
y = 0.0004x + 4.4421
R2 = 0.5386

According to this relationship, penetration should be increased by 11 million lines to "catch up"

LATIN AMERICA: 2008 GAP BETWEEN SUPPLY AND DEMAND FOR BROADBAND

Country	Number of Lines (2008)	Demand estimation according to GDP 2008	2008 Gap
Argentina	3,185,300	3,101,435	No Gap
Brazil	10,098,000	14,800,734	4,702,000
Chile	1,426,400	1,439,173	13,000
Colombia	1,902,800	2,898,369	996,000
Ecuador	210,285	834,481	624,000
El Salvador	123,500	368,036	245,000
México	7,604,600	9,180,576	1,576,000
Nicaragua	45,044	278,656	233,000
Panama	157,500	247,158	90,000
Peru	725,600	1,812,972	1,087,000
Venezuela	1,096,500	2,556,853	1,460,000
Uruguay	287,700	284,841	No Gap
Total	26,864,129	37,803,283	11,026,000 (*)

Sources: World Bank; IDC/Cisco; analysis by the author (*): Sum of all country gaps

The gap in Brazil appears to be heavily concentrated in the Northeast and Southeast
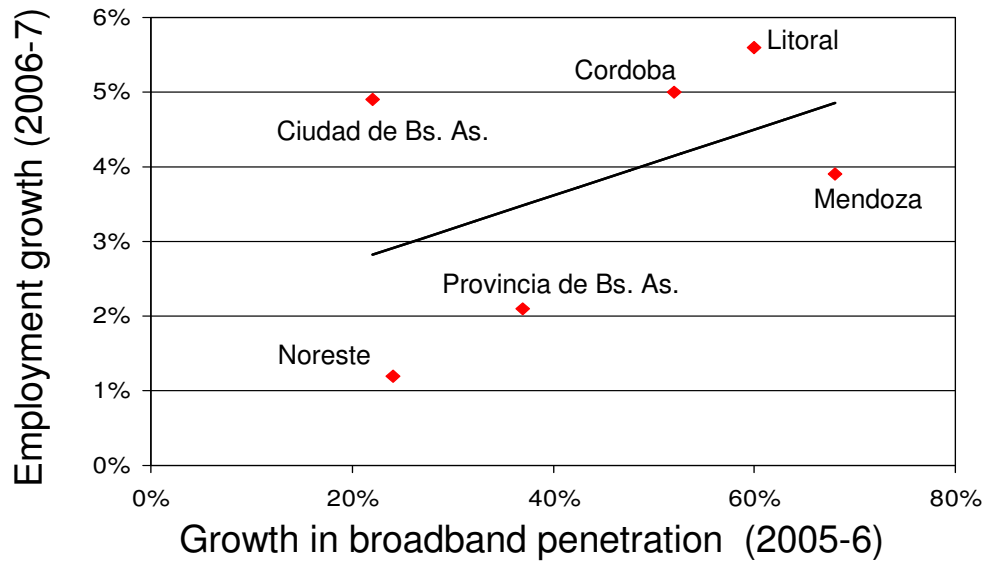
BRAZIL: 2008 GAP BETWEEN SUPPLY AND DEMAND FOR BROADBAND

Region	Number of Lines (Dec 2007)	Penetration (Dec 2007)	Penetration (Dec 2008)	Penetration Gap (2008)	Incremental lines (2008)
Norte	392,527	2.2 %	2.96 %	3.5 %	526,000
Nordeste	416,560	0.8 %	1.09 %	4.8 %	2,675,000
Sudeste	1,601,958	4.8 %	6.24 %	1.7 %	656,000
Sao Paulo	3,012,114	7.1 %	9.1 %	0.2 %	97,000
Sul	1,456,395	5.1 %	6.6 %	1.4 %	374,000
Centro-Oeste	613,737	4.1 %	5.49 %	2.7 %	375,000
Brazil	7,493,000	4.0 %	5.3 %	2.2 %	4,702,000

Sources: IBGE; IDC/Cisco; analysis by the author

ARGENTINA

Employment growth (2006-7) vs Growth in broadband penetration (2005-6)

Litoral, Cordoba, Ciudad de Bs. As., Mendoza, Provincia de Bs. As., Noreste

$$y = 0.044x + 0.0185$$
$$R2 = 0.2278$$

Fuentes: IDC; CEPAL; INDEC; analisis del autor

CHILE

Employment growth (2006-7) vs Growth in broadband penetration (2004-5)

Segunda Region, Quinta Region, Novena Region, Region Metropolitana, Onceava Region, Primera Region, Septima Region, Decima Region, Cuarta Region, Octava Region, Sexta Region
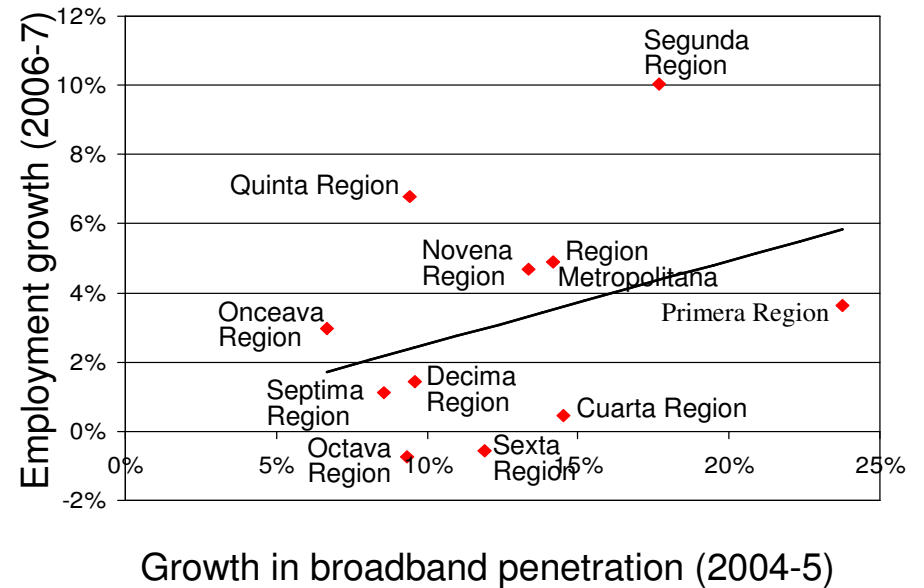
$$y = 0.2408x + 0.0011$$
$$R2 = 0.1264$$

Fuentes: IDC; CEPAL; analisis del autor

Based on the Argentine coefficients, we have estimated the impact on job creation if the supply gap were to be addressed

Employment Growth in t+1 = 0.044 * (Broadband penetration growth in t) + 0.0185

Country	Number of access lines (2008)	Penetration (2008)	Estimation of Demand According to PBI 2008	Broadband Gap 2008	Incremental Penetration	Impact on employment growth
Argentina	3,185,300	7.9 %	3,101,435	No Gap	7.9 %	1.7 %
Brazil	10,098,000	5.3 %	14,800,734	4,702,734	7.7 %	3.9 %
Chile	1,426,400	8.4 %	1,439,173	12,773	8.5 %	1.9 %
Colombia	1,902,800	4.2 %	2,898,369	995,569	6.4 %	4.2 %
Ecuador	210,285	1.5 %	834,481	624,196	6.0 %	14.9 %
El Salvador	123,500	2.0 %	368,036	244,536	6.0 %	10.6 %
Mexico	7,604,600	7.1 %	9,180,576	1,575,976	8.5 %	2.8 %
Nicaragua	45,044	0.8 %	278,656	232,712	4.9 %	24.1 %
Panama	157,500	4.6 %	247,158	89,658	7.2 %	4.4 %
Peru	725,600	2.5 %	1,812,972	1,087,372	6.2 %	8.4 %
Venezuela	1,096,500	3.9 %	2,556,853	1,460,353	9.0 %	7.7 %
Uruguay	287,700	8.6 %	284,841	No Gap	8.6 %	1.8 %
Total	26,864,129	5.5 %	37,803,283	11,025,879	9.9 %	3.6 %

The increase in broadband lines estimated above could yield 370,000 additional jobs

$$\text{Incremental employment due to BB (2006)} = \left(\left(\left(\text{Delta Actual employment 2005-06}\right) * \left(\text{Incremental impact of broadband penetration}\right)\right) * \text{Employment 2005}\right) - \text{Employment 2006}$$

Country	Impact on employment growth rate	Total Employment (2006)	Total Employment (2005)	Delta Employment 2005-06	Impact of broadband on employment growth	Incremental employment estimate
Argentina	1.7 %	10,045,000	9,638,700	4.22 %	4.29 %	7,046
Brazil	3.9 %	84,596,300	80,163,500	5.53 %	5.75 %	172,840
Chile	1.9 %	6,411,000	5,905,000	8.57 %	8.73 %	9,560
Colombia	4.2 %	17,609,000	18,217,000	-3.34 %	-3.48 %	Not significant
Ecuador	14.9 %	4,031,600	3,891,900	3.59 %	4.12 %	20,830
El Salvador	10.6 %	2,685,900	2,591,100	3.66 %	4.05 %	10,013
Mexico	2.8 %	42,197,800	40,791,800	3.45 %	3.54 %	38,832
Nicaragua	24.1 %	1,631,700				
Panama	4.4 %	1,210,700	1,188,300	1.89 %	1.97 %	975
Peru (*)	8.4 %	3,656,700	3,400,300	7.54 %	8.18 %	21,650
Venezuela	7.7 %	11,224,800	10,035,700	11.85 %	12.76 %	91,680
Uruguay	1.8 %	1,413,500	1,114,500	26.83 %	27.31 %	5,401
Total	3.6 %	186,714,000	176,937,800	5.53 %	5.73 %	378,827

(*) Estimated population of Lima
Sources: ILO; analysis by the author

This estimate is at the lower bound of employment creation

- The estimate is based on impact of employment growth between 2005 and 2006

- The estimate underestimates construction effects in Argentina and Uruguay and uneven broadband distribution between capitals and the interior

- Due to the lack of national employment statistics for Peru, the job creation estimate for this country includes only Lima and Callao

Agenda

- What do we know about the economic impact of broadband?

- The current situation of broadband in Latin America

- An estimation of broadband demand and its employment impact in Latin America

- Conclusions and research agenda

Policy and research implications

- Big opportunity for Latin America to catch up with regards broadband diffusion

- While current penetration is 5.5% (26,800,000 lines), we estimate conservatively a gap of 11,000,000 lines which could yield a penetration of 7.7%; this could take two-three years to be achieved at current historical rates (assuming that investment rates were to be continued)

- If Latin America were to fill up the demand gap, this could have employment impact both from a direct/indirect/induced effects (derived from construction) and positive externalities

- While it is difficult to decouple construction from other effects, regression-based forecasting allows us to estimate conservatively an employment impact of 378,000

- Future research should be conducted at the disaggregated national level to validate these top-down estimates