Columbia Business School

Estimating Broadband Demand and its economic impact in Latin America

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III Conference ACORN-Redecom

Mexico, D.F.
September 4, 2009

(*) The author would like to acknowledge Javier Avila, researcher at Citi for the analytical support

Agenda

- Research literature on the economic impact of broadband
- The current situation of broadband in Latin America
- An estimation of broadband demand
- Employment impact of broadband in Latin America
- Conclusions and research agenda

Three types of research on economic impact of broadband

	Global Economy	National Economies	Regional Economies
Input-Output Analysis		• Crandall et al. (2003) • Katz et al. (2008) • Atkinson et al. (2009) • Katz et al. (2009a) • Katz et al. (2009b) • Liebenau et al (2009)	• Strategic Networks Group (2003)
Multivariate Regression Modeling	• Gentzoglanis (2007) • Koutroumpis (2009)	• Lehr et al. (2006) • Crandall et al. (2007) • Thompson et al. (2008) • Katz (2009) • Katz et al (2009b)	• Kelly (2004) • Ford and Koutsky (2005)

What do we know so far about 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 networks has important direct and indirect employment effects •The induced effects of network construction magnify the total impact of network deployment •While in certain countries total industrial output generated by the deployment of broadband is significant, the proportion of imported goods is increasing, thereby reducing the amount of jobs being created •Network externalities once broadband is deployed have also significant economic impact	•How many jobs can be lost as a result of productivity induced broadband? There are initial job losses in less developed areas •A broadband investment program could create new jobs in the targeted region but result in job losses in another one, with limited incremental national impact: what is the impact?	•What is the relationship between faster broadband speeds and employment beyond DSL/cable modem? •Is there a broadband saturation point beyond which network externalities tend to substantially diminish?

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

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	37,300	31,000	59,500	127,800	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	134,000	541,000	1.45	1.94
UNITED KINGDOM	$ 7,463	76,452	134,541		211,000		2.78
AUSTRALIA	$ 31,340				200,000		

(*) (Direct + indirect)/direct

(**) (Direct + indirect + induced)/direct

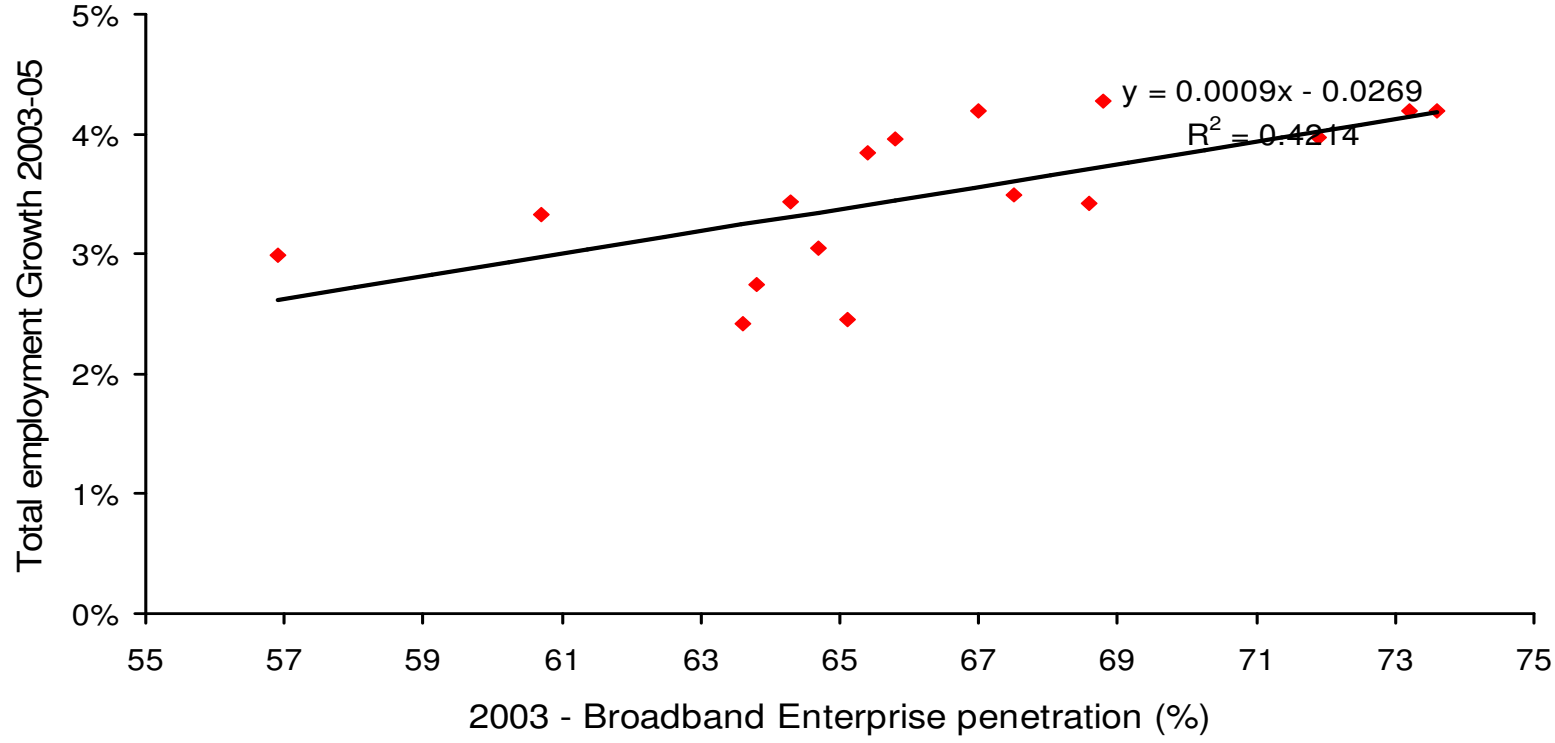
Sources: Katz, R. and Suter, S. (2009). *Estimating the economic impact of the US broadband stimulus plan, Columbia Institute for Tele-Information working paper;* Katz, R., P. Zenhäusern, S. Suter, P. Mahler and S. Vaterlaus (2008). *Economic Modeling of the Investment in FTTH*. unpublished report; Katz, R., S. Vaterlaus, P. Zenhäusern, S. Suter and P. Mahler (2009). *The Impact of Broadband on Jobs and the German Economy. Liebenau et al. (2009); Australian government*

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

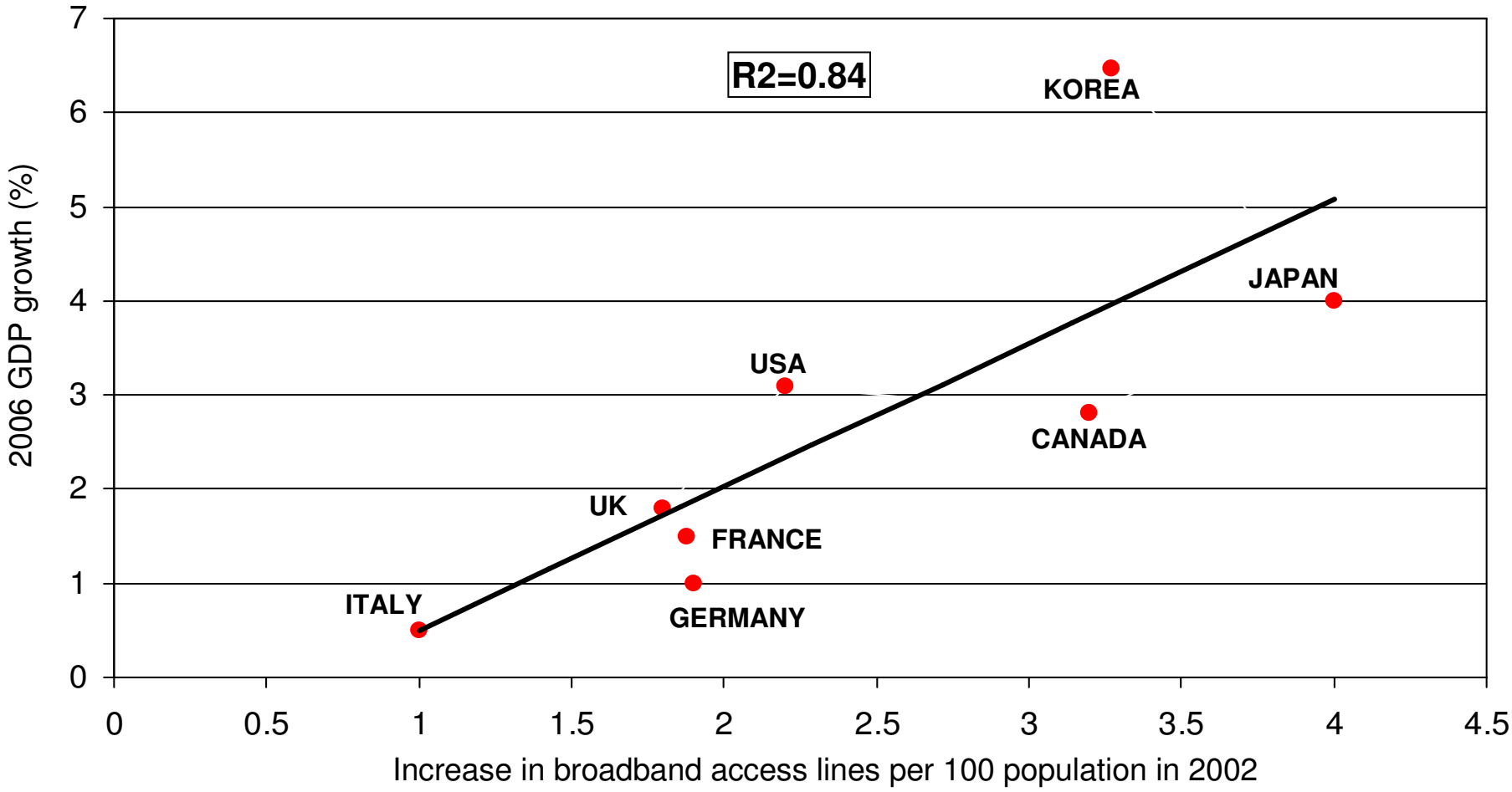
Aggregate studies partially help understand the positive externalities

SPAIN AUTONOMOUS COMMUNITIES: RELATIONSHIP BETWEEN BROADBAND PENETRATION AND EMPLOYMENT GROWTH



Sources: Katz (2009)

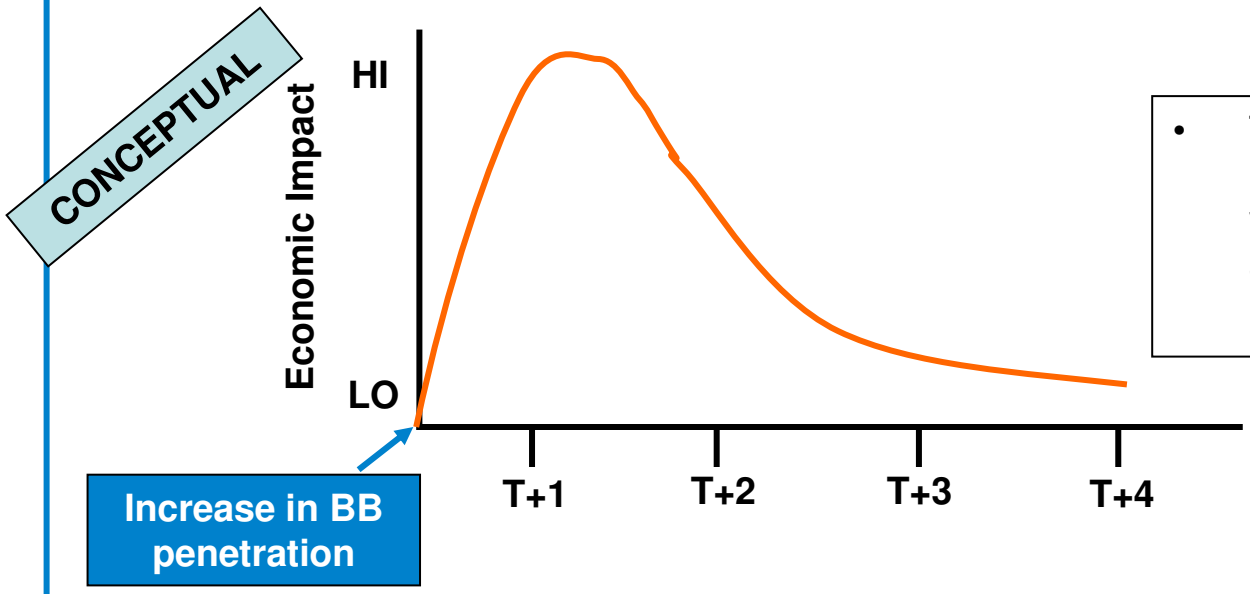
National studies bring back the direction of causality discussion



Sources: Gentzoglanis (2007)

However, national studies have found network externalities to be significant: our German research

- Our analysis estimates the impact of increase in broadband penetration on rate of economic growth and job creation
  - 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



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

Results of the regression analysis at the national level indicate high significance regarding the economic growth effect

BROADBAND AS A DRIVER OF GDP

$$\Delta GDP_{t+1} = f((GDP/Pop)_{2000}, \Delta Pop_{2000-06}, \Delta BBPen_t)$$
$$\Delta GDP_{t+2} = f((GDP/Pop)_{2000}, \Delta Pop_{2000-06}, \Delta BBPen_t)$$
$$\Delta GDP_{t+3} = f((GDP/Pop)_{2000}, \Delta Pop_{2000-06}, \Delta BBPen_t)$$

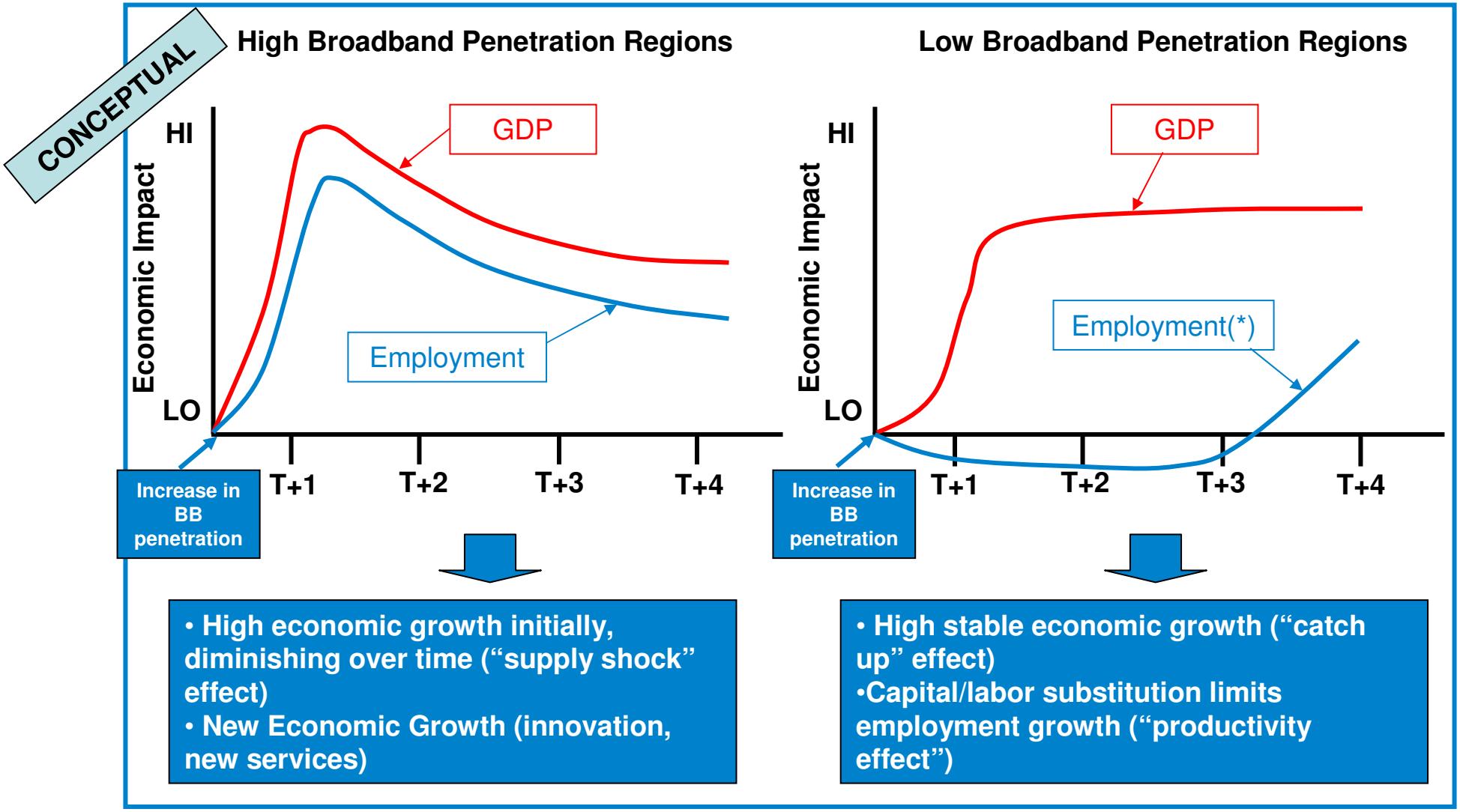
Dependent Variable: Growth of GDP between 2003 and 2006 G_GDP (03-06) = β1 * GDP_Capita_2000 + β2 * G_POP (00-06) + β3 * G_BBPEN (02-03)	Total	
GDP per Capita 2000 (* 1'000'000)	0.0261	
	(0.041)	
Population growth (2000 - 2006)	0.6318	***
	(0.075)	
Broadband penetration growth (2002 - 2003)	0.0255	***
	(0.002)	
R^2 adjusted	0.6317	
Number of Observations	424	

*Note: ***,** and * indicate a significance level of 1%, 10% and 15%.*
Standard errors in parentheses.

$$\Delta GDP_{02-03} = 4.03e-07 * (GDP/Pop)_{2000} + 0.427 * \Delta Pop_{2000-06} + 0.0027 * \Delta BBPen_{2001-02}$$
$$\Delta GDP_{03-04} = 3.89e-07 * (GDP/Pop)_{2000} + 0.409 * \Delta Pop_{2000-06} + 0.0026 * \Delta BBPen_{2001-02}$$
$$\Delta GDP_{04-05} = 3.81e-07 * (GDP/Pop)_{2000} + 0.395 * \Delta Pop_{2000-06} + 0.0025 * \Delta BBPen_{2001-02}$$

The ß coefficient diminishes over time indicating a reduction in the intensity of broadband impact on GDP

Furthermore. different economic impact profiles at the regional level result from different levels of broadband penetration



(*) Results are at a low significance level

The regression results for both regions illustrate the two different impact patterns

Growth of GDP

Dependent Variable: Growth of GDP between 2003 and 2006

G_GDP (03-06) = □1 * GDP_Capita_2000 + □2 * G_POP (00-06) + □3 * G_BBPEN (02-03)

	Total	Low Penetration	High Penetration
GDP per Capita 2000 (* 1'000'000)	0.0261	0.0627	0.0185
	(0.041)	(0.121)	(0.050)
Population growth (2000 - 2006)	0.6318 ***	0.5311 ***	0.7731 ***
	(0.075)	(0.102)	(0.116)
Broadband penetration growth (2002 - 2003)	0.0255 ***	0.0238 ***	0.0256 ***
	(0.002)	(0.005)	(0.003)
R^2 adjusted	0.6317	0.6321	0.6305
Number of Observations	424	210	214

*Note: ***,** and * indicate a significance level of 1%, 10% and 15%.*
Standard errors in parentheses.

Growth of Employment

Dependent Variable: Growth of Employment between 2003 and 2006

G_EMP (03-06) = □1 * GDP_Capita_2000 + □2 * G_POP (00-06) + □3 * G_BBPEN (02-03)

	Total	Low Penetration	High Penetration
GDP per Capita 2000 (* 1'000'000)	0.0362 *	-0.0066	0.0030
	(0.024)	(0.072)	(0.029)
Population growth (2000 - 2006)	1.0481 ***	1.1265 ***	0.9072 ***
	(0.044)	(0.061)	(0.066)
Broadband penetration growth (2002 - 2003)	0.0020 *	0.0027	0.0061 ***
	(0.001)	(0.003)	(0.002)
R^2 adjusted	0.6065	0.6597	0.5557
Number of Observations	424	210	214

*Note: ***,** and * indicate a significance level of 1%, 10% and 15%.*
Standard errors in parentheses.

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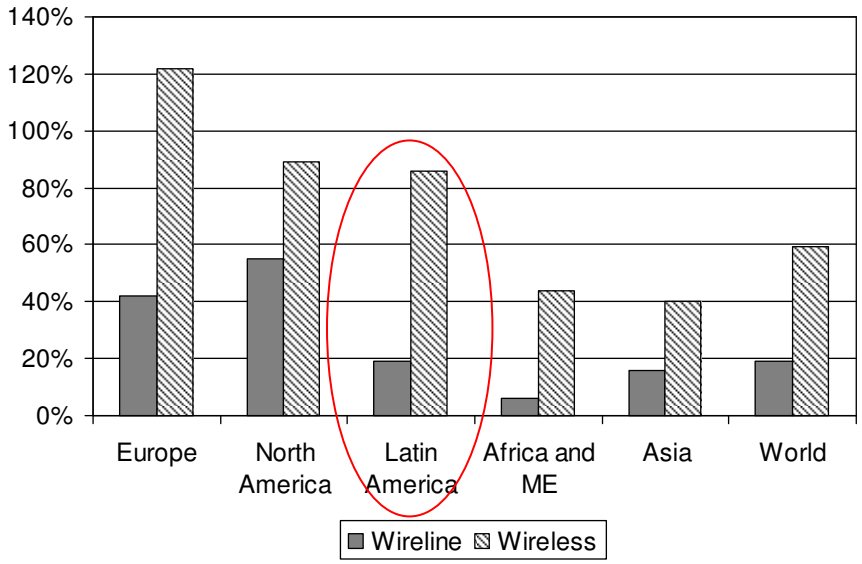
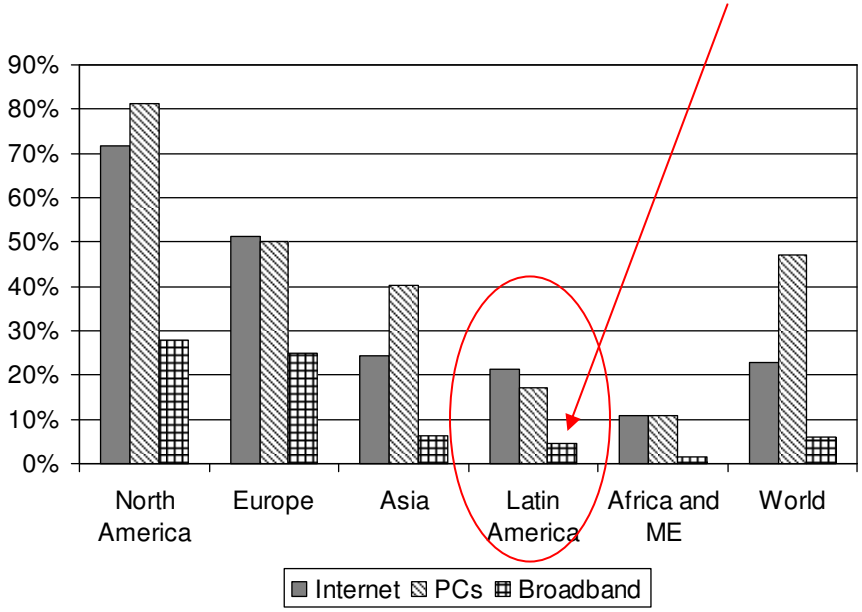
Latin America lags in broadband penetration per population

VOICE TELEPHONY (2008)



INTERNET USAGE, PC AND BROADBAND (2008)



Sources: ITU; regulatory authorities; compiled by the author

Penetration statistics, adjusted by speed standards, have to be reduced

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 %

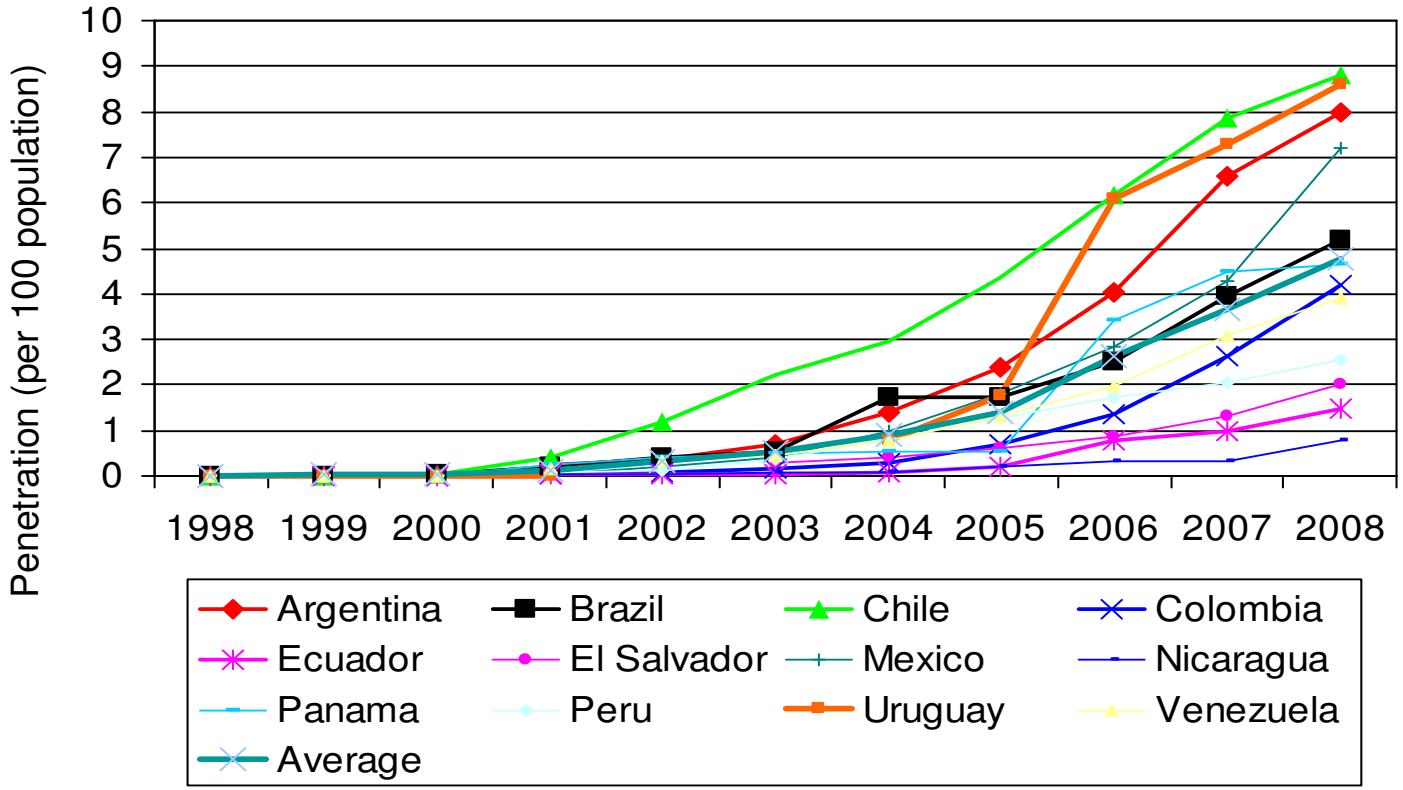
Sources: IDC/Cisco

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 %

However, year to year growth has been explosive since 2007 indicating unmet demand

LATIN AMERICA: BRODBAND 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 %

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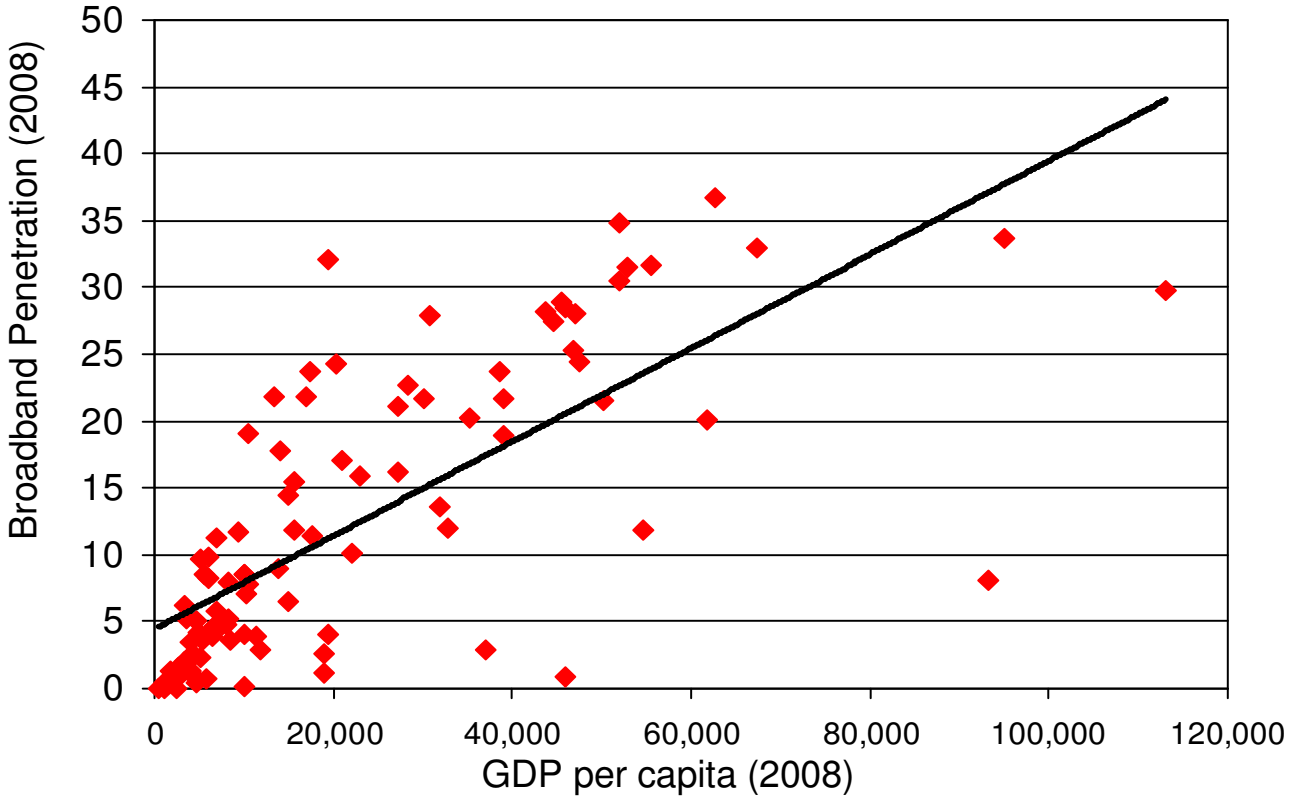
Our demand estimates are based on the relationship between level of economic development and broadband penetration



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

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	4,702,734
Chile	1,426,400	1,439,173	12,773
Colombia	1,902,800	2,898,369	995,569
Ecuador	210,285	834,481	624,196
El Salvador	123,500	368,036	244,536
México	7,604,600	9,180,576	1,575,976
Nicaragua	45,044	278,656	232,712
Panama	157,500	247,158	89,658
Peru	725,600	1,812,972	1,087,372
Venezuela	1,096,500	2,556,853	1,460,353
Uruguay	287,700	284,841	No Gap
Total	26,864,129	37,803,283	11,025,879 (*)

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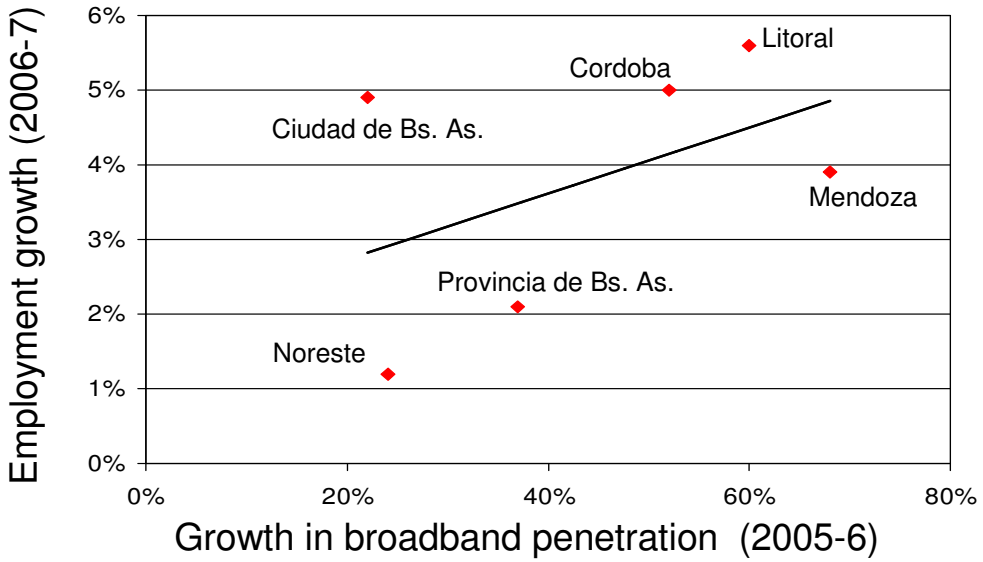
Broadband has already had some impact in job creation in the region

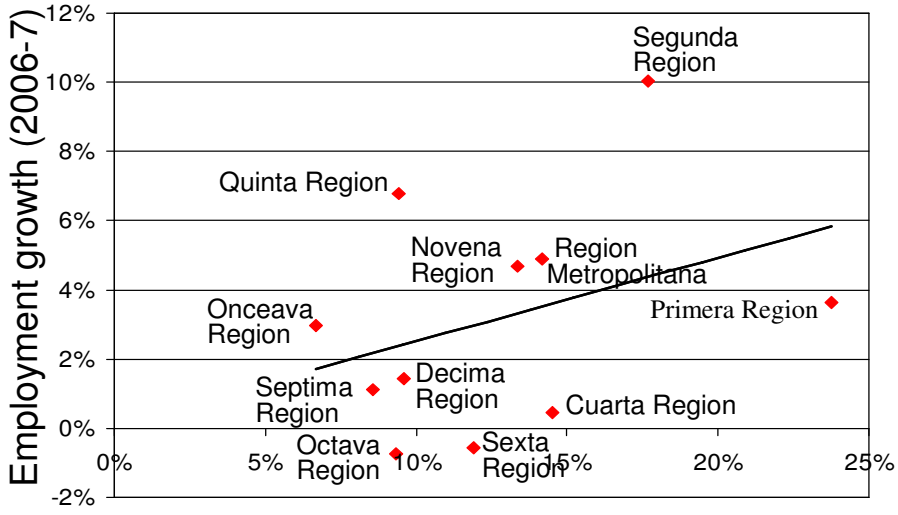
ARGENTINA



y = 0.044x + 0.0185
R2 = 0.2278

Fuentes: IDC; CEPAL; INDEC; analisis del autor

CHILE



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

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

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

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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
  - This estimate underestimates construction effects in Argentina and Uruguay
  - Due to the lack of national employment statistics for Peru, the job creation estimate for this country includes only Lima and Callao
- Future research should be conducted at the disaggregated national level to validate these top-down estimates